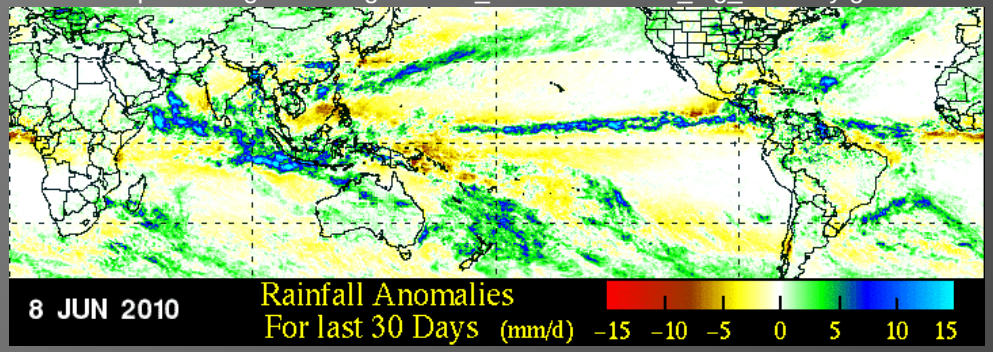
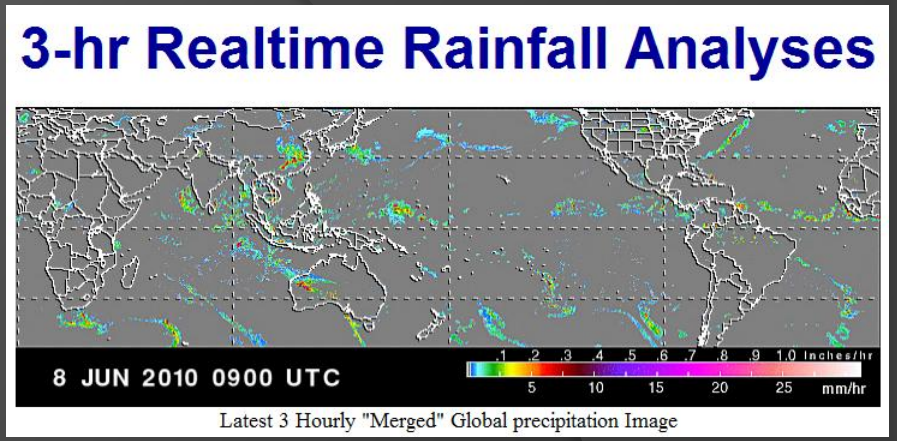
http://trmm.gsfc.nasa.gov/trmm_rain/Events/new_big_anomaly.gif



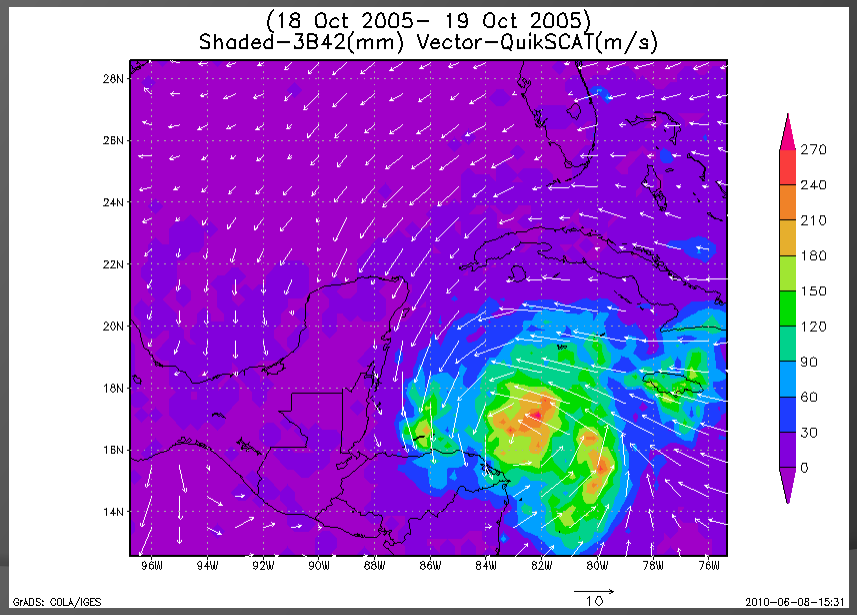
http://precip.gsfc.nasa.gov/rain_pages/3hrly.html



Latest 3 Hourly "Merged" Global precipitation Image

TRMM TOOLS FOR HYDROLOGY ANALYSIS

Amanda DePasquale
GSFC Summer Intern



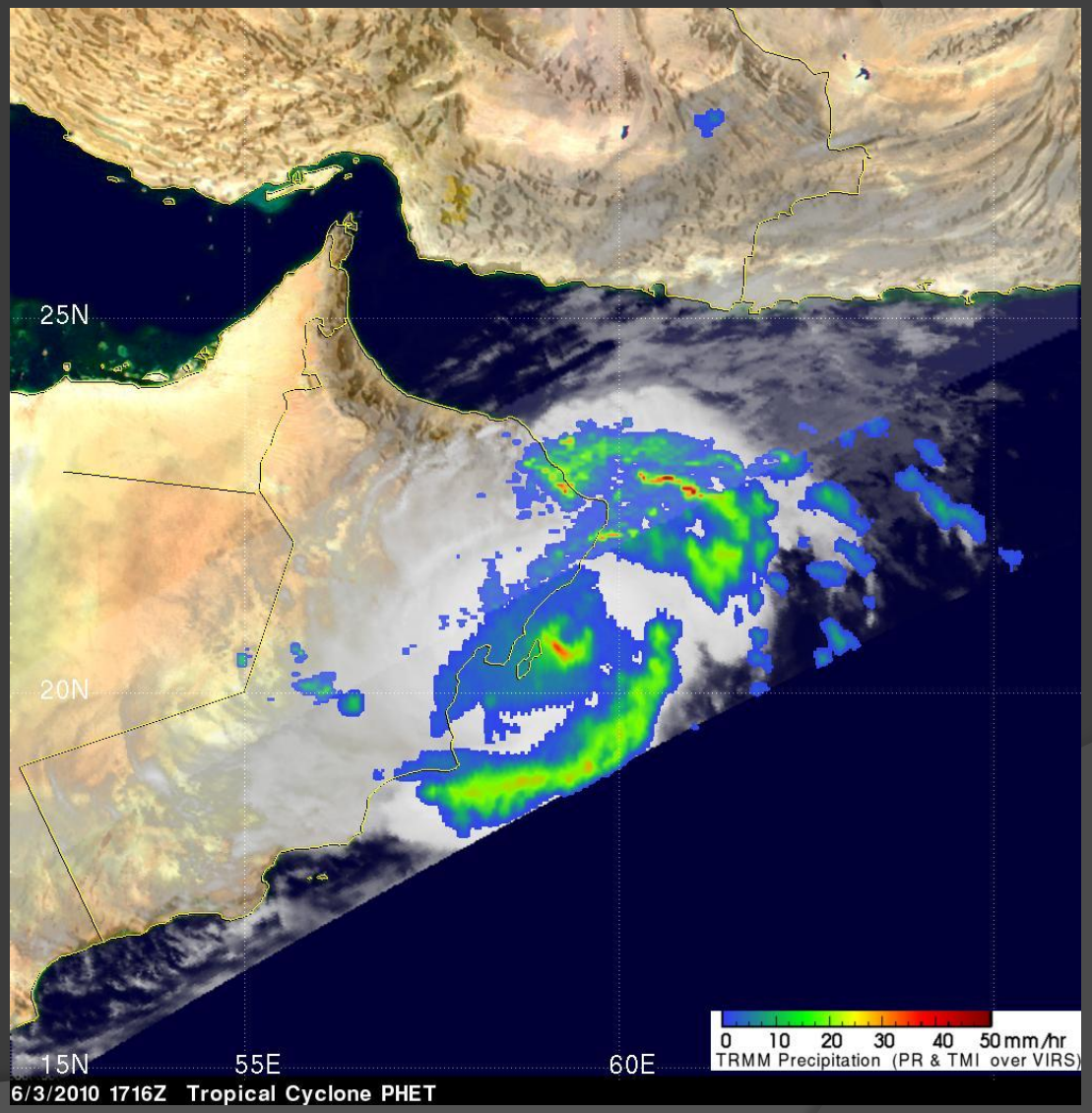
Generated with: http://disc.sci.gsfc.nasa.gov/daac-bin/hurricane_data_analysis_tool.pl

Outline

- Background on TRMM
- Applications
- Tools that can be used to look at the data
- Case study

Background on TRMM

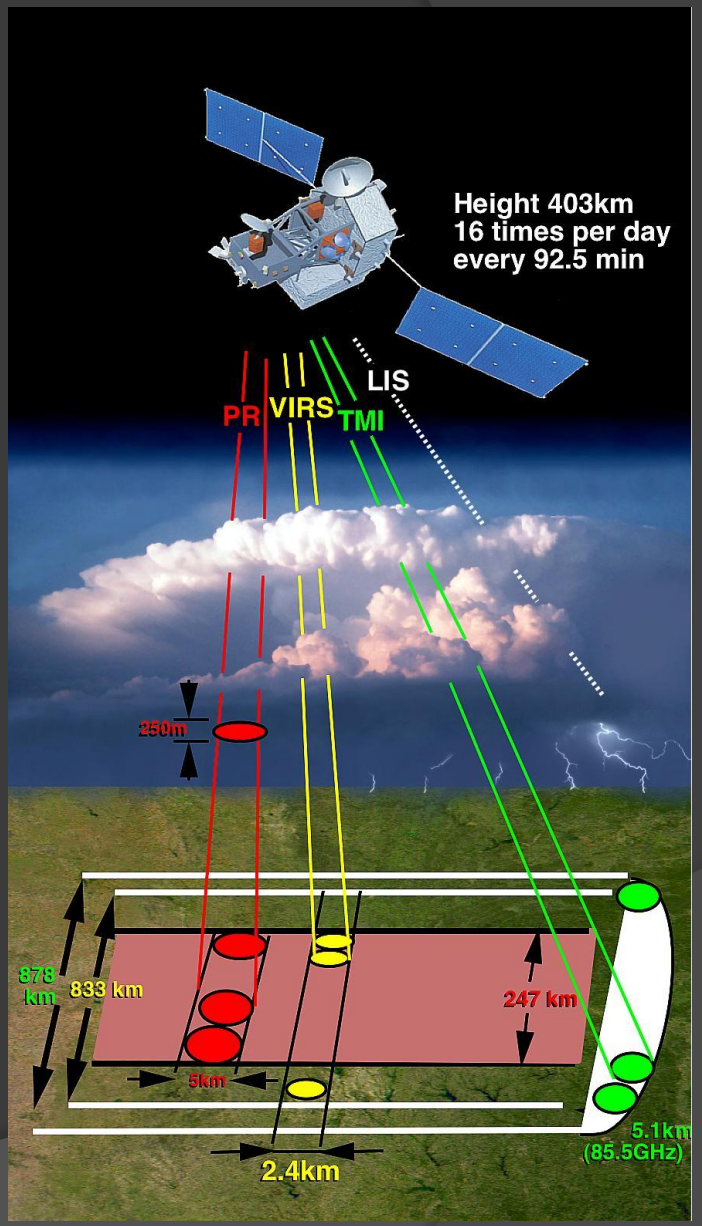
- **T**ropical **R**ainfall **M**easuring **M**ission
- Joint mission between NASA & JAXA
- Designed to monitor and study tropical rainfall



http://trmm.gsfc.nasa.gov/trmm_rain/Events/phet_3jun10_1716_utc.jpg

TRMM Instruments

- **Precipitation Radar (PR):** provides 3-D maps of storm structure, including intensity, rain distribution, storm depth, and height where snow melts to become rain
- **Visible and InfraRed Scanner (VIRS):** senses outgoing radiation from earth from visible to infrared wavelengths, detecting rainfall
- **TRMM Microwave Imager (TMI):** passive sensor that measures microwave energy emitted by earth to quantify water vapor, cloud water, and rainfall intensity in the atmosphere
- **Lightning Imaging Sensor (LIS):** detects and locates lightning
- **Clouds and the Earth's Radiant Energy System (CERES):** measures energy at the top of the atmosphere and estimates energy in the atmosphere; also determines cloud-amount, altitude, thickness, and size of cloud particles



http://trmm.gsfc.nasa.gov/overview_dir/trmm_instrument_large.jpg

TRMM Mission

- Collects data between 35°S and 35°N, and adds composite data from TRMM and other satellite and meteorological data to extend the range from 50°S to 50°N
- Travels 403 km over the atmosphere, making 16 orbits a day every 92.5 minutes
- Provides 4-D (3-D plus time) distribution of rainfall and latent heating
- First satellite mission to establish global distribution of rainfall on earth’s surface

Applications of TRMM

- Rainfall measurements, especially over oceans and the Southern Hemisphere
- Analysis and tracking of hurricanes and typhoons
- Global flood and landslide monitoring
- Fire potential monitoring
- Analysis of rainfall averages, anomalies, and climatology, including the ENSO cycle
- Gain valuable hydrological data about developing countries
- SST, surface wind speed, atmospheric water vapor, cloud liquid water, and rain rate analysis over oceans

Tools to look at TRMM data

- TRMM NASA
- TRMM JAXA
- Giovanni
- Hurricane Analysis Tool
- SERVIR
- NASA Earth Observations (NEO)
- Global Precipitation Analysis (GPCP)
- Remote Sensing Systems (RSS)
- TRMM – University of Utah

Best Tools for Accessing General Archive Data:

- Giovanni
- Hurricane Analysis Tool

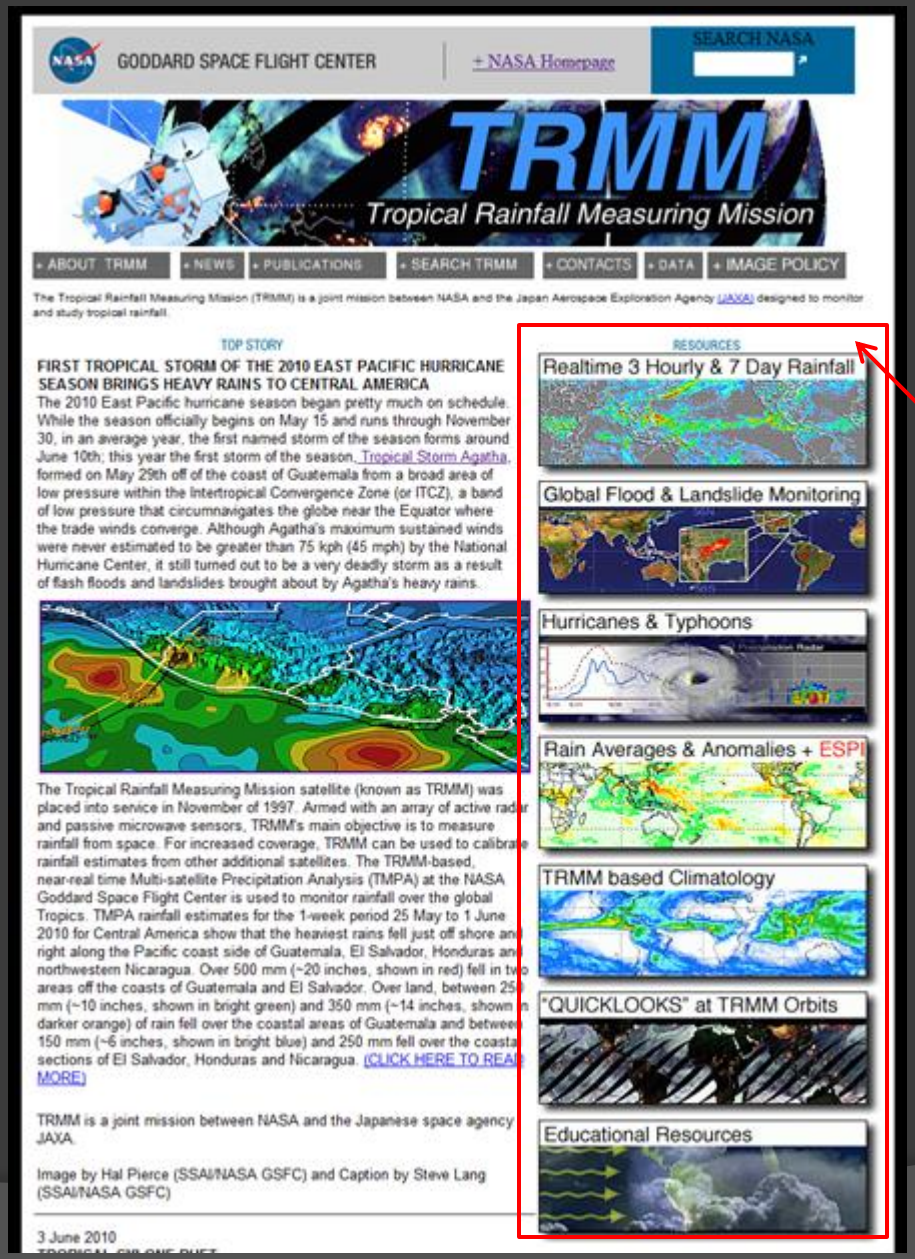
Best Tools for Accessing Recent & Near Real-Time Data:

- TRMM NASA
- TRMM JAXA
- Giovanni
- SERVIR
- NEO
- GPCP
- RSS

Best Tools for Accessing Pre-mapped/Pre-compiled Data:

- TRMM NASA
- TRMM JAXA
- NEO
- GPCP
- TRMM U of Utah

TRMM - NASA

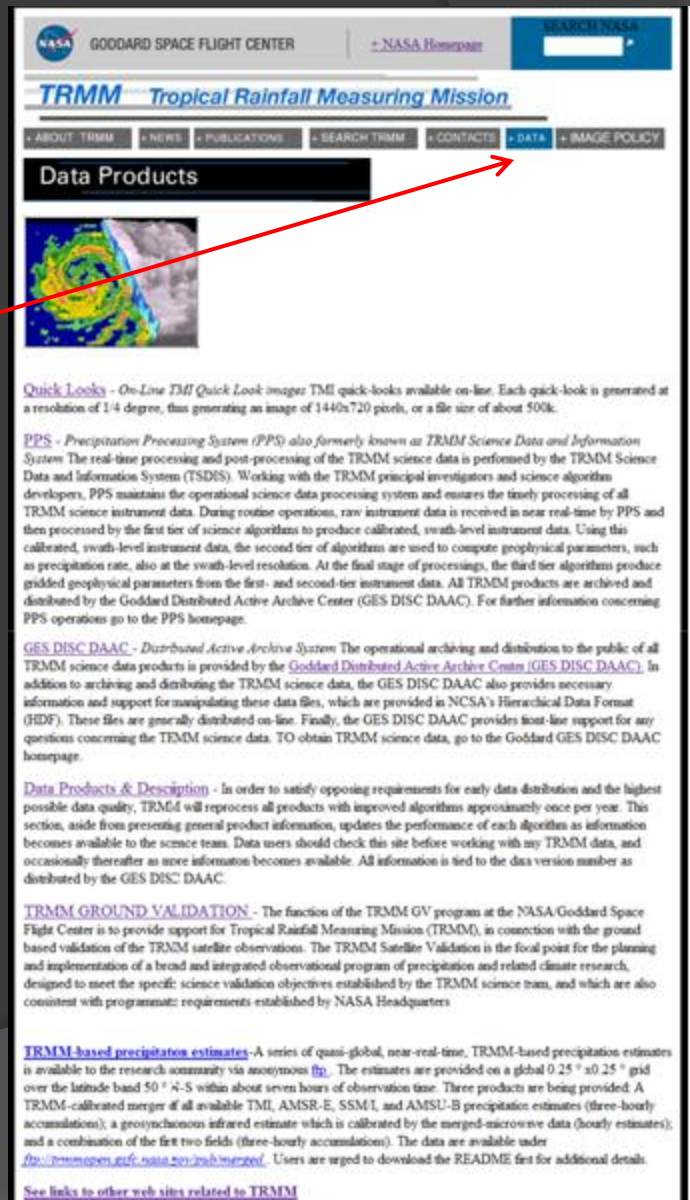


- http://trmm.gsfc.nasa.gov
- The TRMM website describes the TRMM mission, instruments, news, publications, and data collected
- The homepage includes Top Stories of events that TRMM has been used to analyze
- The resources on the right of the page give the user access to a multitude of information (these links will be explored further on the subsequent slides):
  - Real time 3 hourly and 7 day rainfall
  - Global flood and landslide monitoring
  - Hurricanes and typhoons
  - Rain averages and anomalies + ESPI
  - Climatology
  - QuickLooks at orbits
  - Educational resources

TRMM - NASA

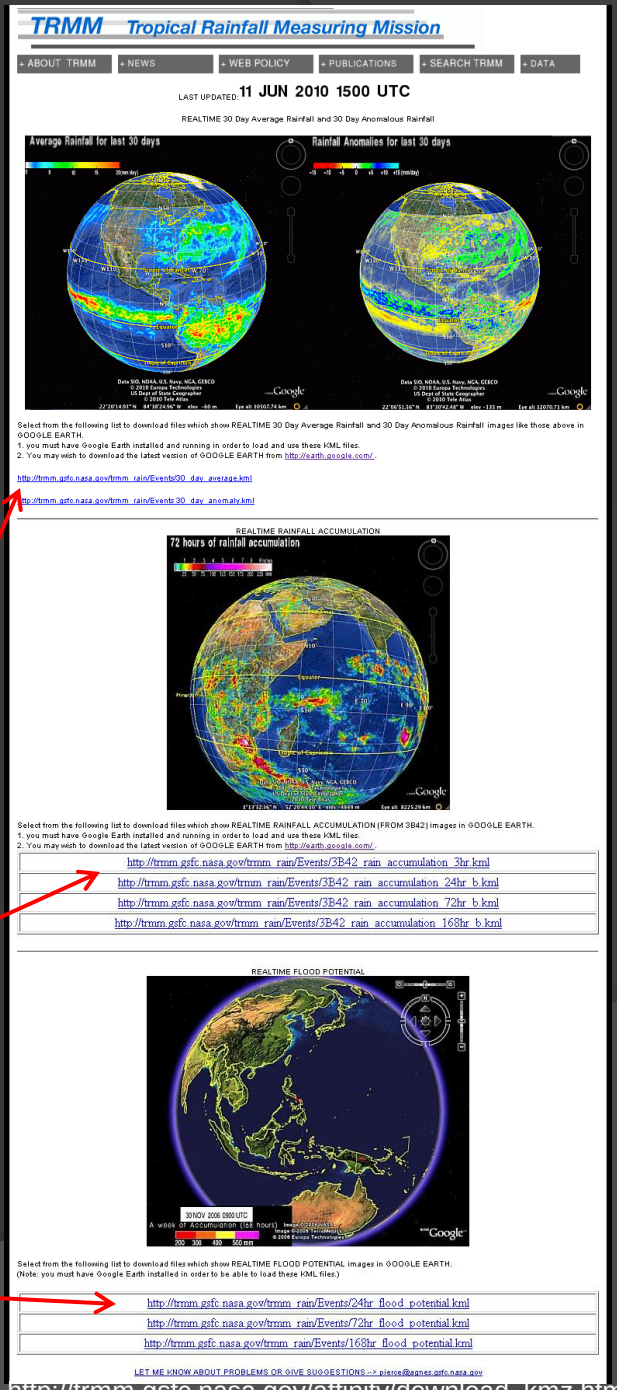
Google Earth Downloads Updated:
11 JUN 2010 1500 UTC

- At the bottom of the homepage, there is a link to download Google Earth imagery from TRMM that is updated daily
- Clicking on the +DATA tab at the top of the homepage brings the user to a set of links to Data Products from TRMM
  - These links provide data downloads and links to other useful pages that use TRMM data



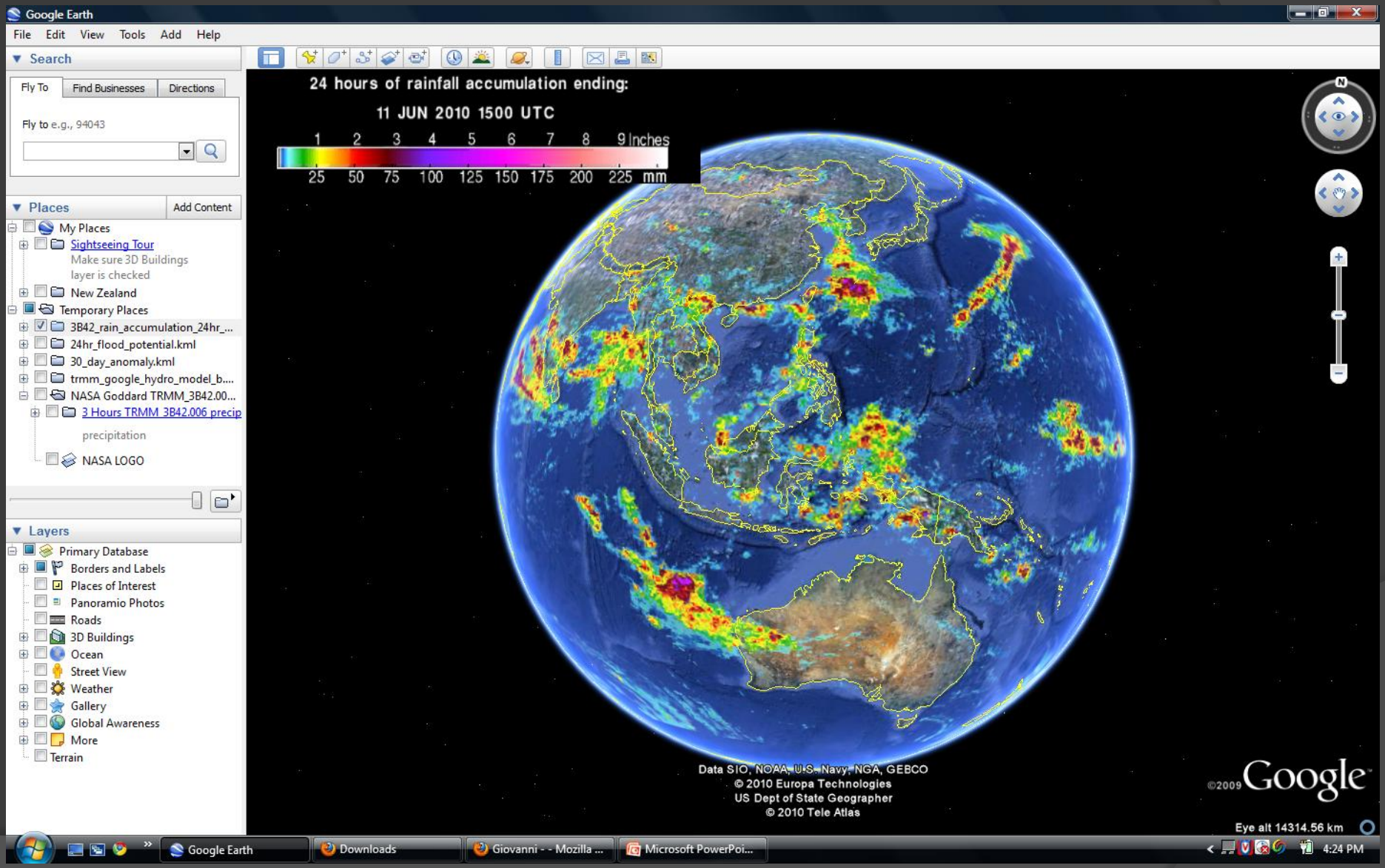
Google Earth Downloads Updated:
11 JUN 2010 1500 UTC

- The Google Earth link brings the user to a new page
- Updated daily, this page includes 3 sections of global Google Earth data
  - Top section: links to realtime 30 day rainfall average and 30 day rainfall anomaly (mm/hr) globally
  - Middle section: links to realtime rainfall accumulation for 3 hr, 24 hr, 72 hr, and 168 hr data
  - Bottom section: links to realtime flood potential for 24 hr, 72 hr, and 168 hr time periods

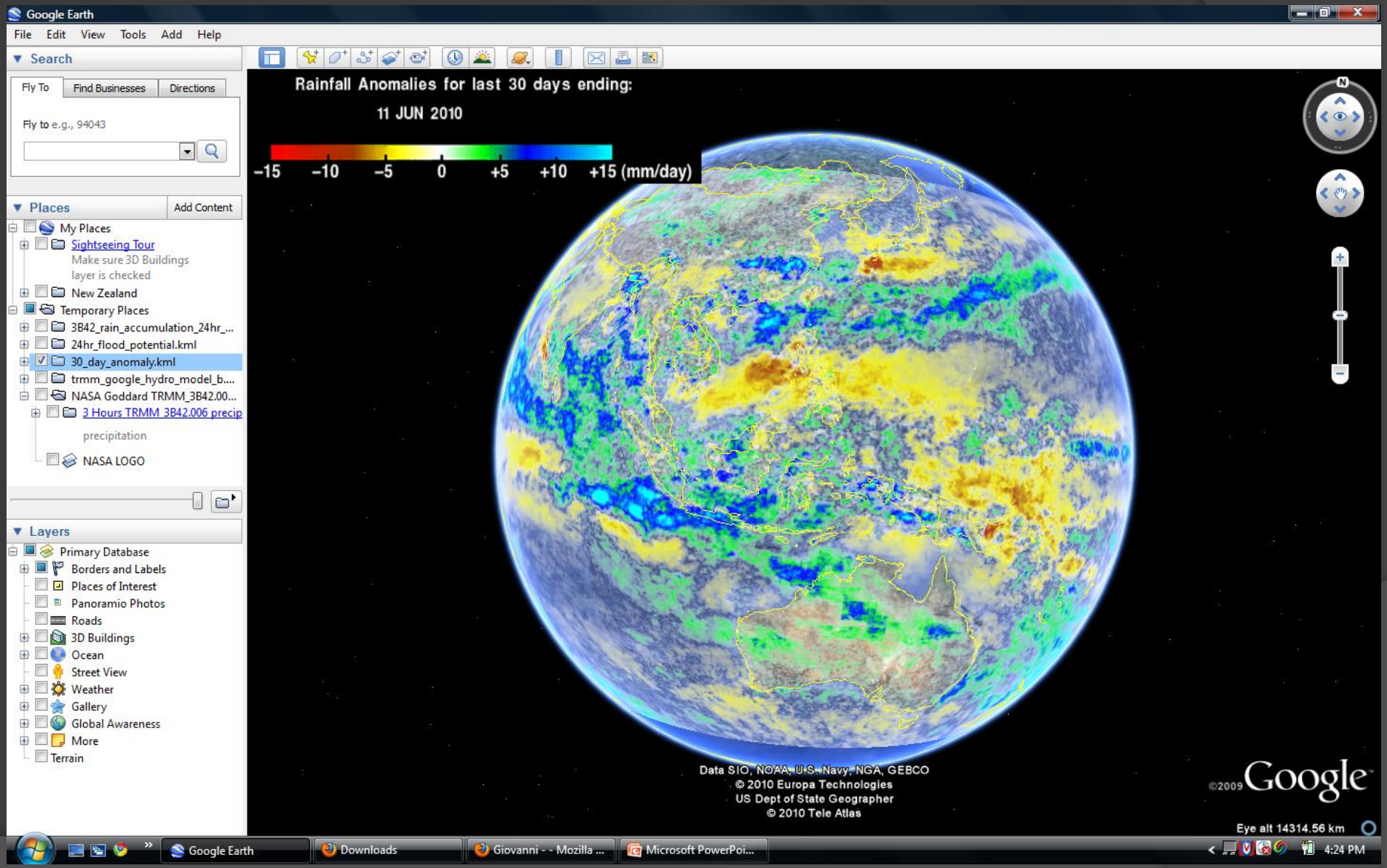


http://trmm.gsfc.nasa.gov/affinity/download_kmz.html

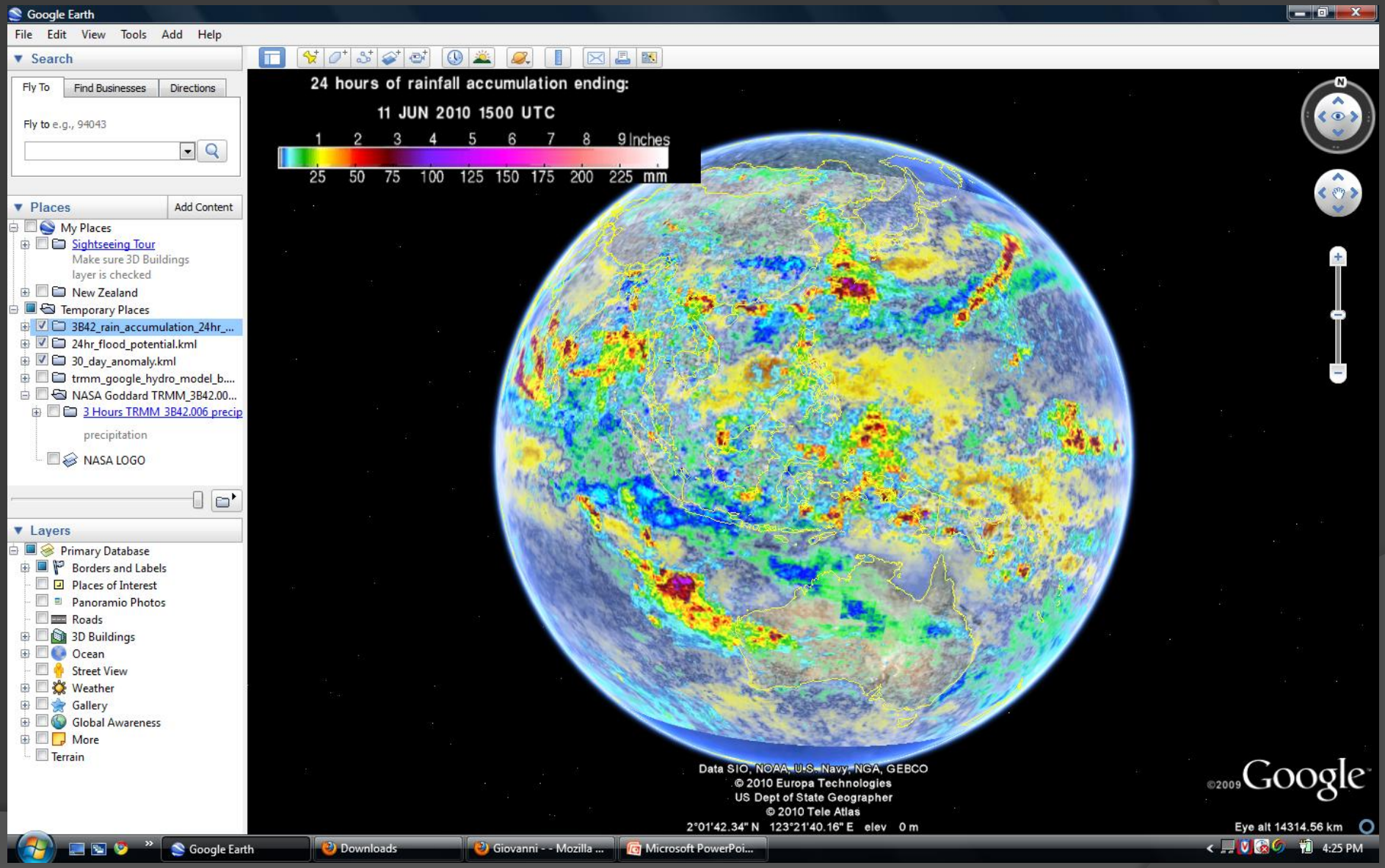
Realtime Rainfall Accumulation Image in Google Earth



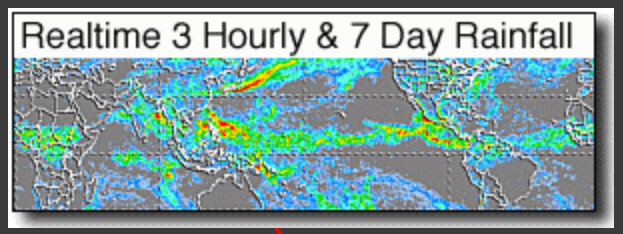
Rainfall Anomaly Image in Google Earth

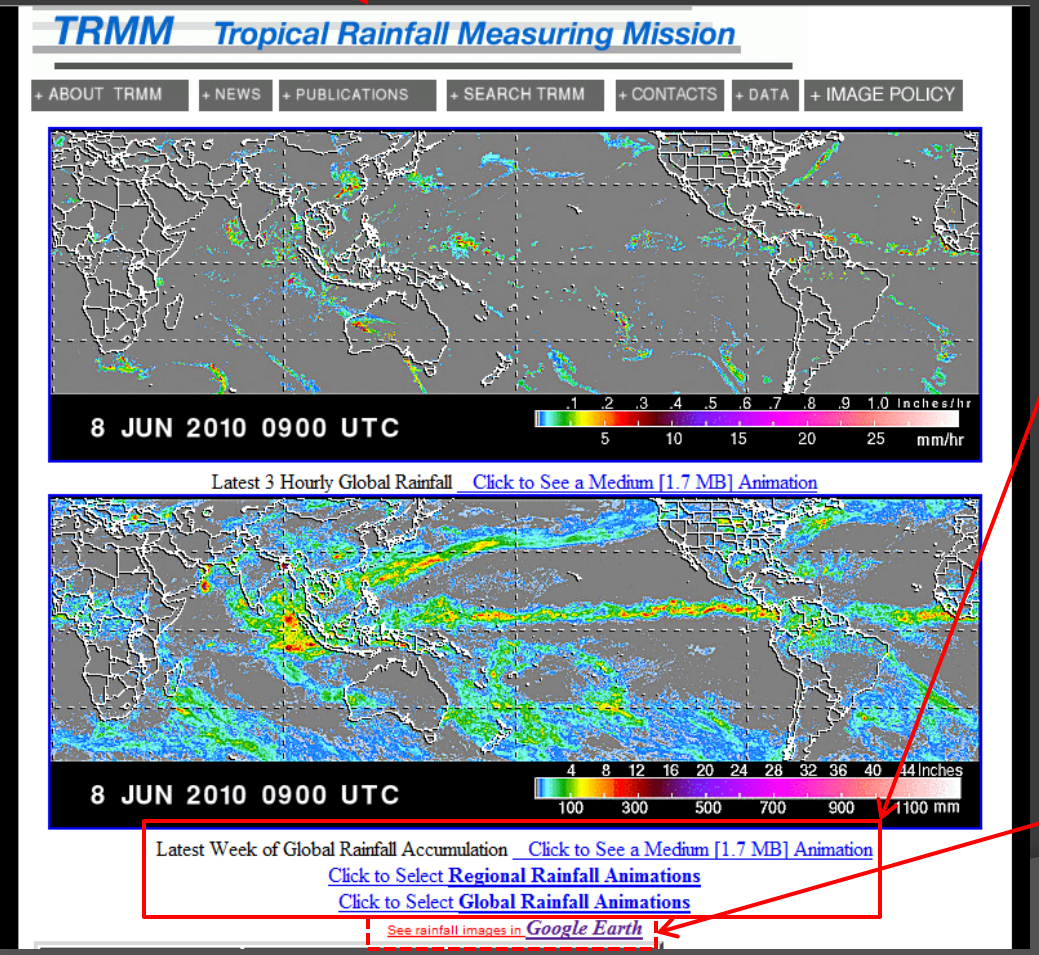


Realtime Rainfall Accumulation, 24 hr Flood Potential, 30 Day Anomaly Images Layered in Google Earth



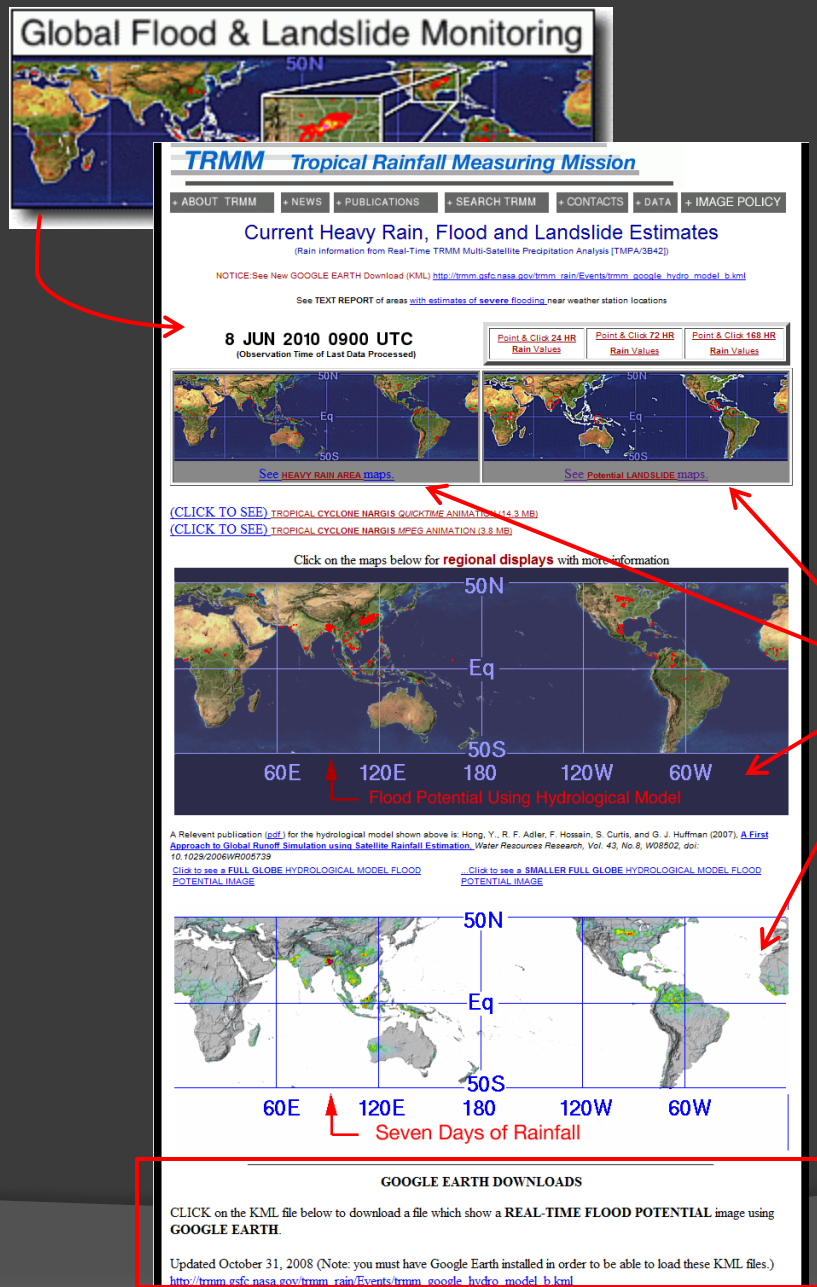
TRMM – NASA: Resources





- Realtime 3 Hourly & 7 Day Rainfall brings the user to a site with two Realtime maps
- At the bottom of the page, there are links for a weekly animation, and regional and global rainfall animations
- There is also a link to view the data in Google Earth (takes the user to the same page as the Google Earth link on the homepage)

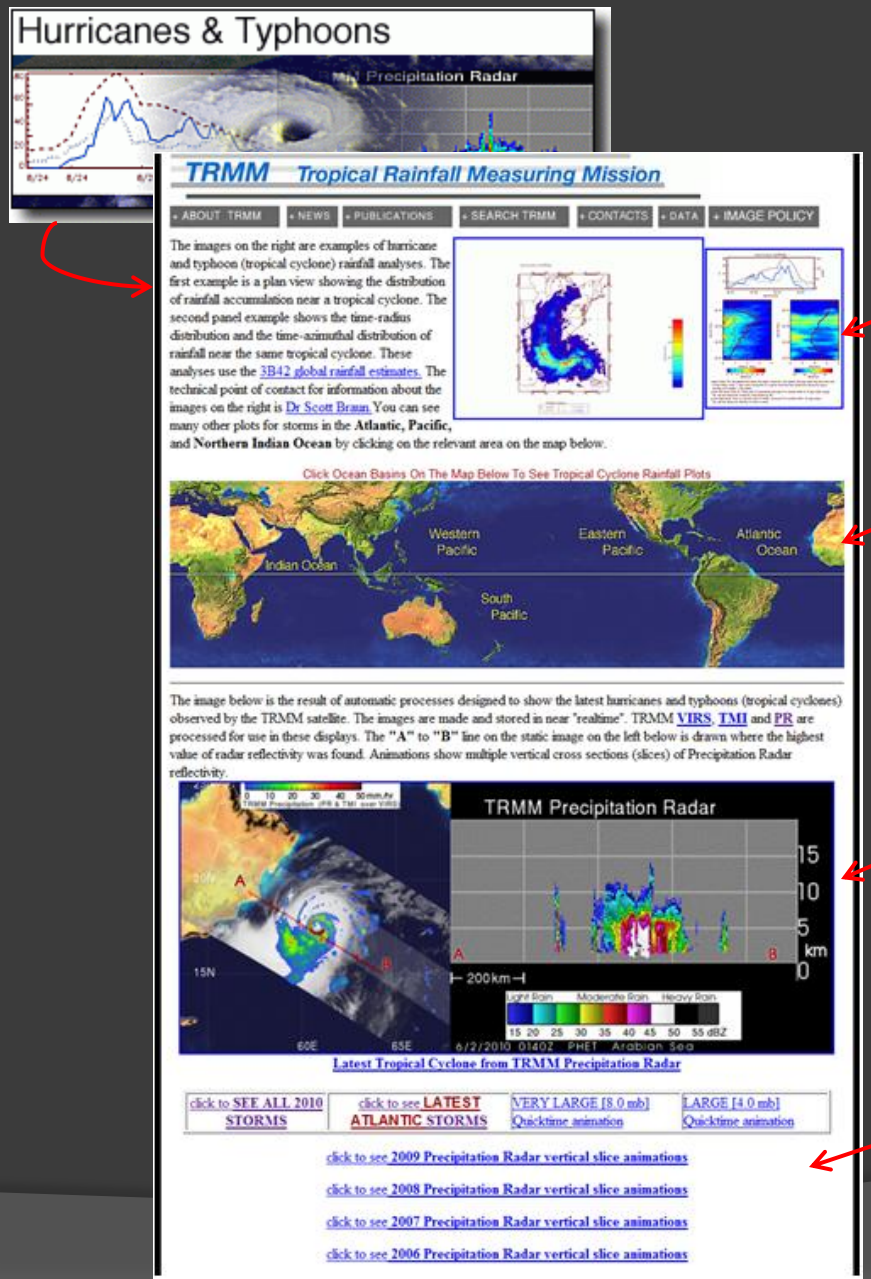
TRMM – NASA: Resources



- Global Flood & Landslide Monitoring is a very useful site for observing maps of heavy rain, floor, and landslide estimates globally
- Clicking on any of the maps brings the user to more in depth analysis by region
- The user can also download the data into Google Earth

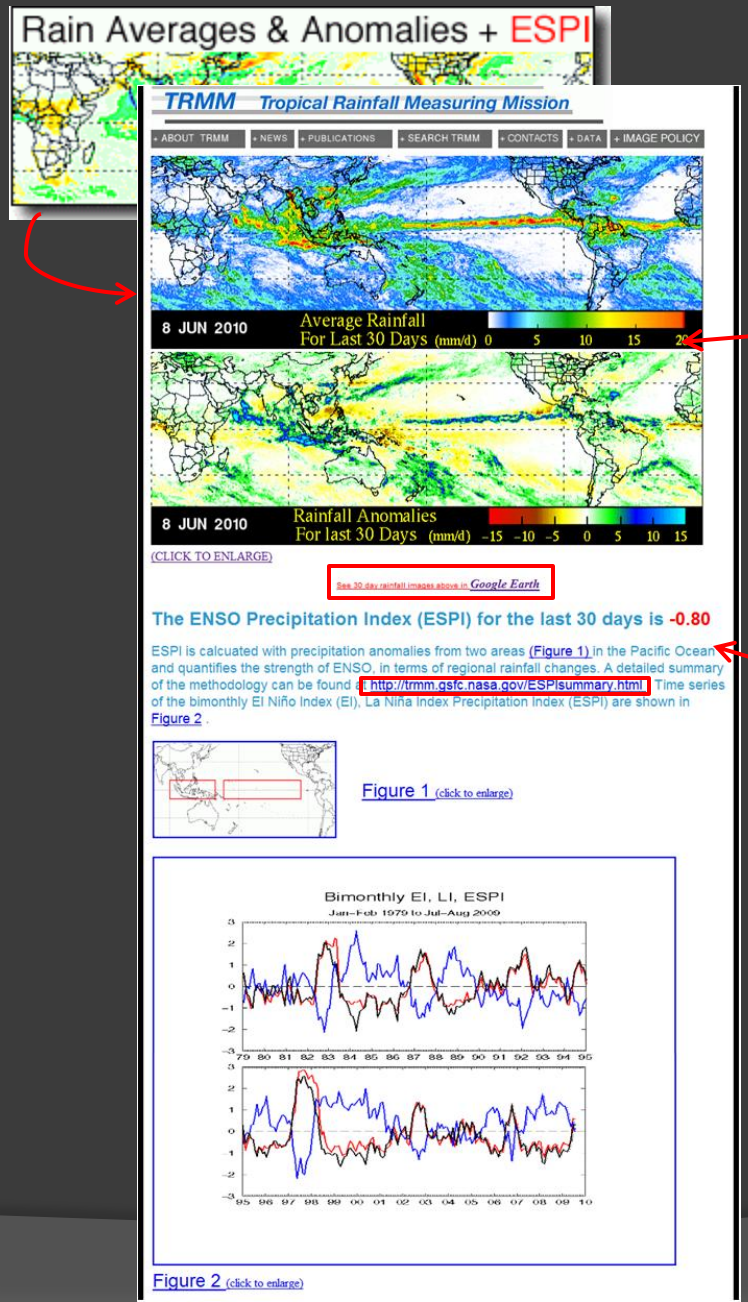
Flood Potential Image in Google Earth

TRMM – NASA: Resources



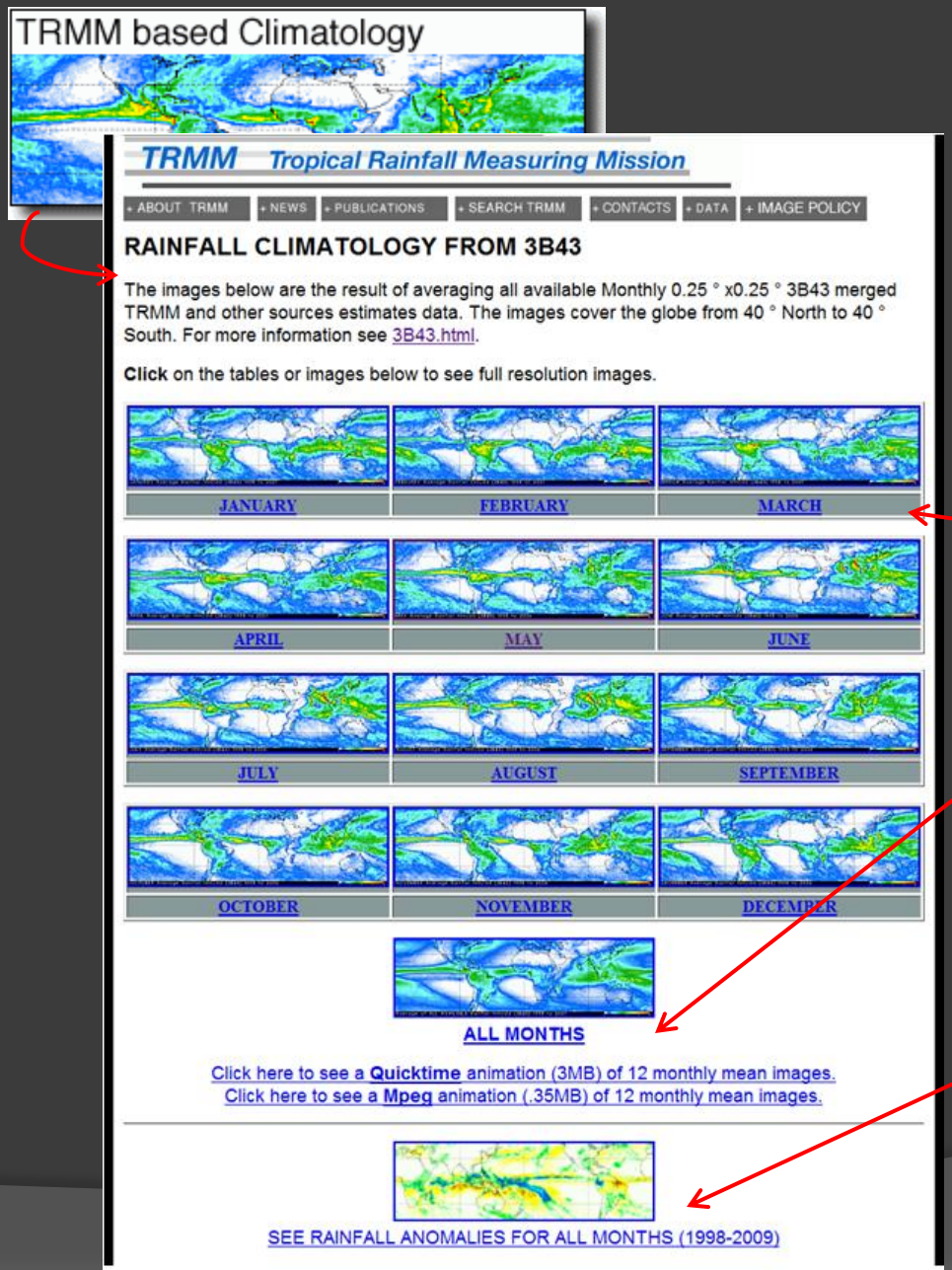
- Hurricanes & Typhoons is an analysis of tropical cyclones globally
- The first section explains the two types of analysis maps that are included on the page, using historical examples
- By clicking on an ocean basin on the map, the user is connected to a page with links to historical tropical cyclone precipitation maps and time series maps separated by year and name of storm from 1998 to 2006
- The next section includes a description of how TRMM data can be used to look at tropical cyclone rain and precipitation radar as vertical cross section slices
- Links at the bottom include this year's storms, this year's animations, and previous precipitation radar animations

TRMM – NASA: Resources



- Rain Averages & Anomalies + ESPI is excellent for looking at monthly trends in rainfall and examining the ENSO cycle
- The first section displays maps of average rainfall and rainfall anomalies for the last 30 days
  - This includes a link to view the maps in Google Earth (takes the user to the same page as the Google Earth link on the homepage)
- The next section deals with ENSO and analyzing the current and past conditions using the ENSO Precipitation Index (ESPI)
  - ESPI is a precipitation based measure of ENSO using precipitation anomalies across the equatorial Pacific
  - For a summary of the indices in ESPI, click the link, or visit: http://trmm.gsfc.nasa.gov/ESPIsummary.html

TRMM – NASA: Resources

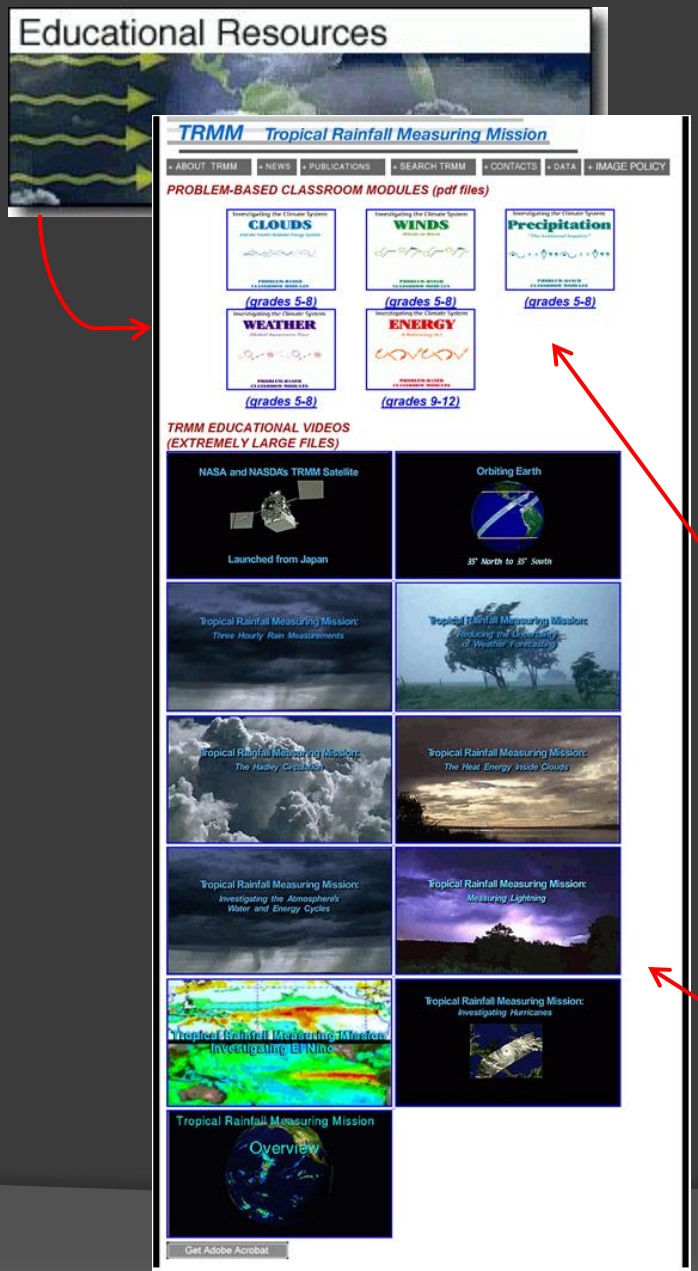


- TRMM based Climatology is the average monthly global rainfall based on 3B43 merged TRMM and other data from 1998 to 2009
  - Climatology is defined as average weather conditions over a period of time, and is used to develop relationships, build models, make forecasts, and find patterns in the weather over time
- By clicking on the months, the user can view the full resolution images
- The user can also access the yearly averaged total rainfall map from 1998 to 2008 and animations of the images
- Finally, the user can view monthly global rainfall anomalies by clicking the last link
  - This opens a new page with maps of rainfall anomalies from 1998 to 2010

TRMM – NASA: Resources

- "QUICKLOOKS" is a map of the TMI data collected by TRMM during its orbit
- The main map displays the current day's data
- The legend explains what each color represents
- The user can also view other orbits from the current and previous months, and past years

TRMM – NASA: Resources

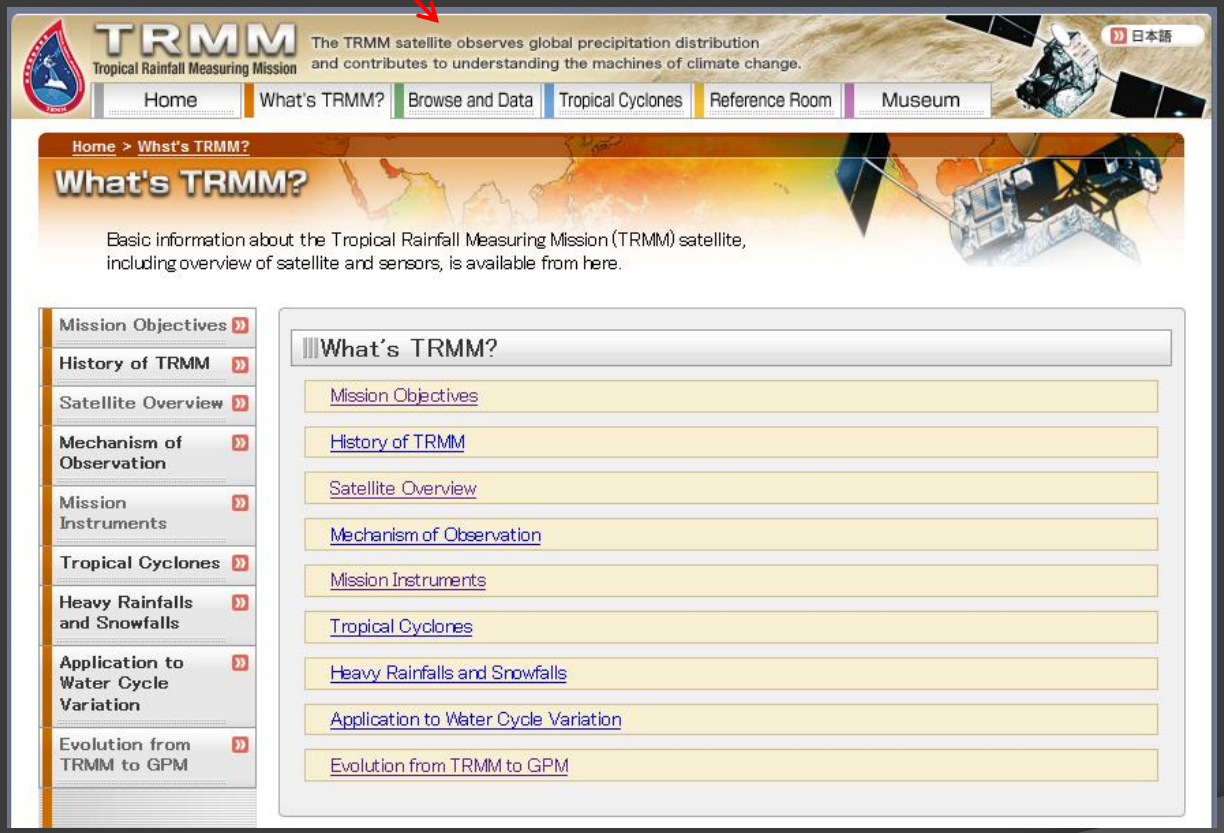


- Educational Resources features a set of tools used to teach people about the climate system and the TRMM mission
- Problem-based classroom PDF Modules are available for grades 5-8 (clouds, winds, precipitation, weather) and 9-12 (energy)
- A variety of videos examining different aspect of the TRMM mission are also available

TRMM - JAXA

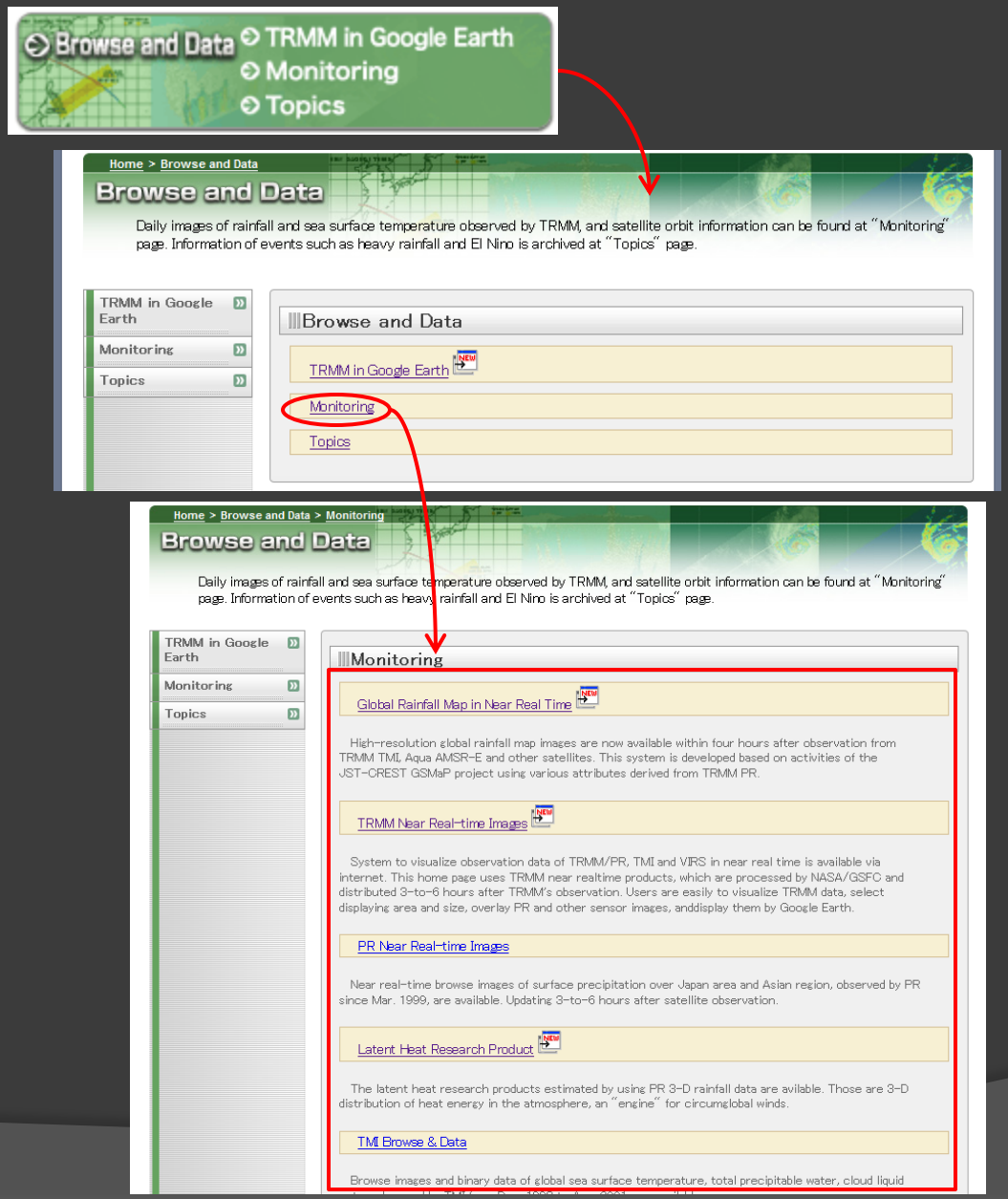
- http://www.eorc.jaxa.jp/TRMM/index_e.htm
- JAXA's website has 5 subsections describing the TRMM mission and data:
  - What's TRMM?
  - Browse and Data
  - Tropical Cyclones
  - Reference Room
  - Museum
- Also links to News, Google Earth Laboratory, World Disasters, Cyclone Monitoring and Database, GPM, Global Rainfall Map and other images in Near-Real-Time, and Latent Heat Research Project

TRMM – JAXA: What's TRMM?



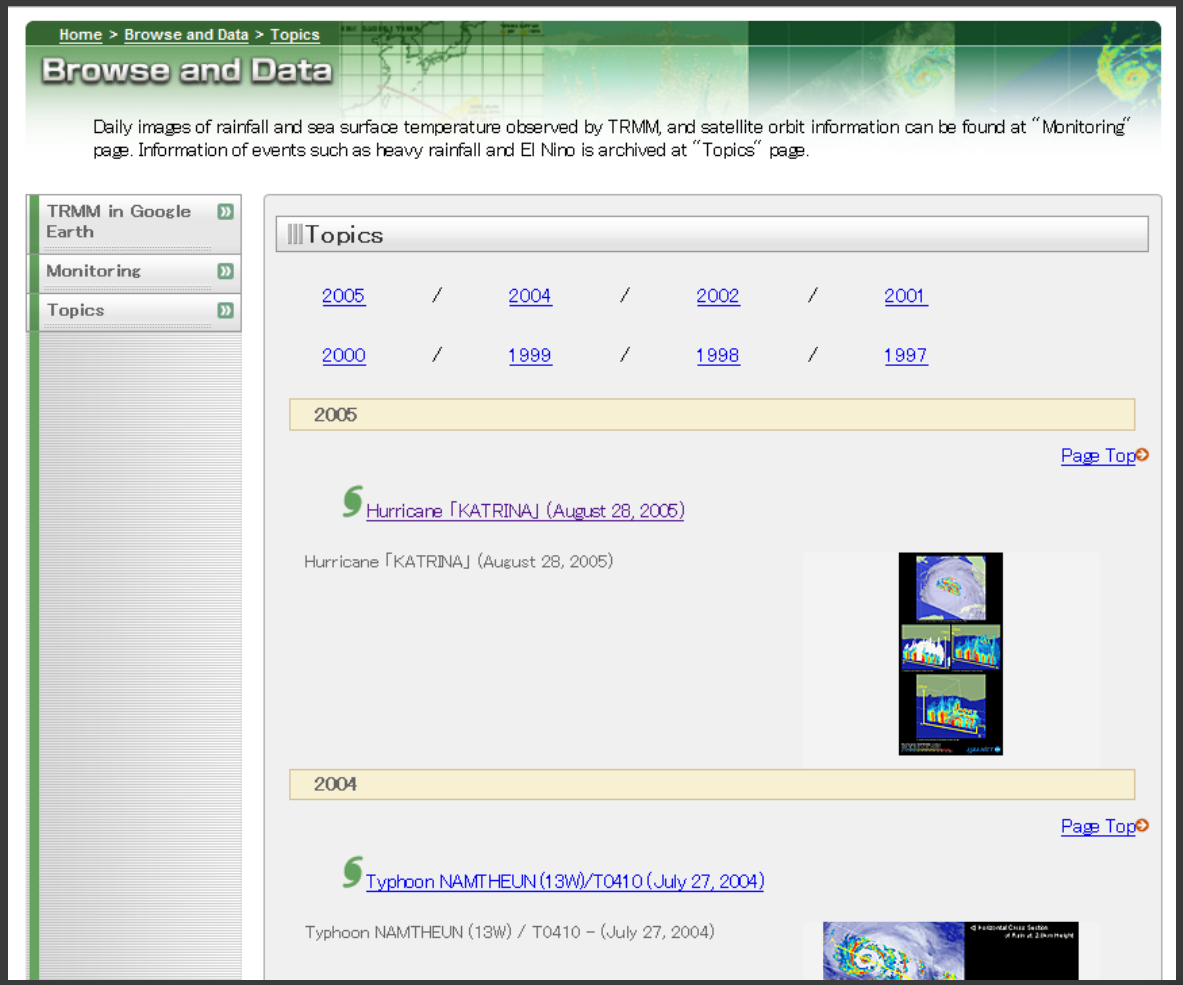
- What's TRMM? Has valuable information about the TRMM mission and its importance
- With a variety of subsections, the user can learn everything about the satellite and even the future of TRMM

TRMM – JAXA: Browse and Data



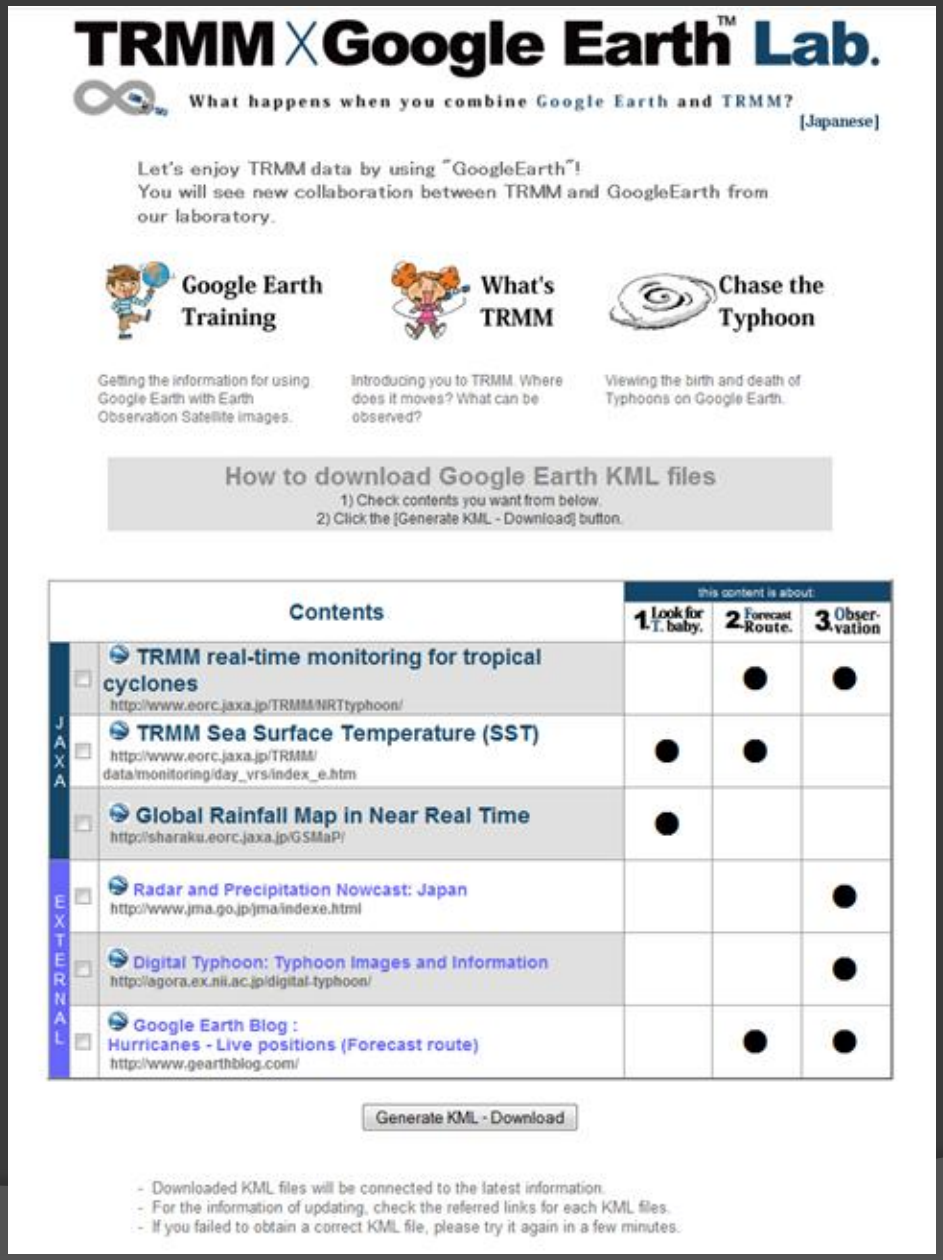
- Browse and Data includes subsections for Google Earth, monitoring, and specific topics
- Clicking the Monitoring link brings the user to another page of links of maps based on TRMM data
- Each link allows the user to chose dates and regions for examination

TRMM – JAXA: Browse and Data



- "Topics" is devoted to specific natural events that were analyzed using TRMM data
- Topics are separated by year

TRMM – JAXA: Browse and Data



TRMM X Google Earth™ Lab.

What happens when you combine Google Earth and TRMM? [Japanese]

Let's enjoy TRMM data by using "GoogleEarth"!
You will see new collaboration between TRMM and GoogleEarth from our laboratory.

Google Earth Training — Getting the information for using Google Earth with Earth Observation Satellite images.

What's TRMM — Introducing you to TRMM. Where does it moves? What can be observed?

Chase the Typhoon — Viewing the birth and death of Typhoons on Google Earth.

How to download Google Earth KML files

1) Check contents you want from below.
2) Click the [Generate KML - Download] button.

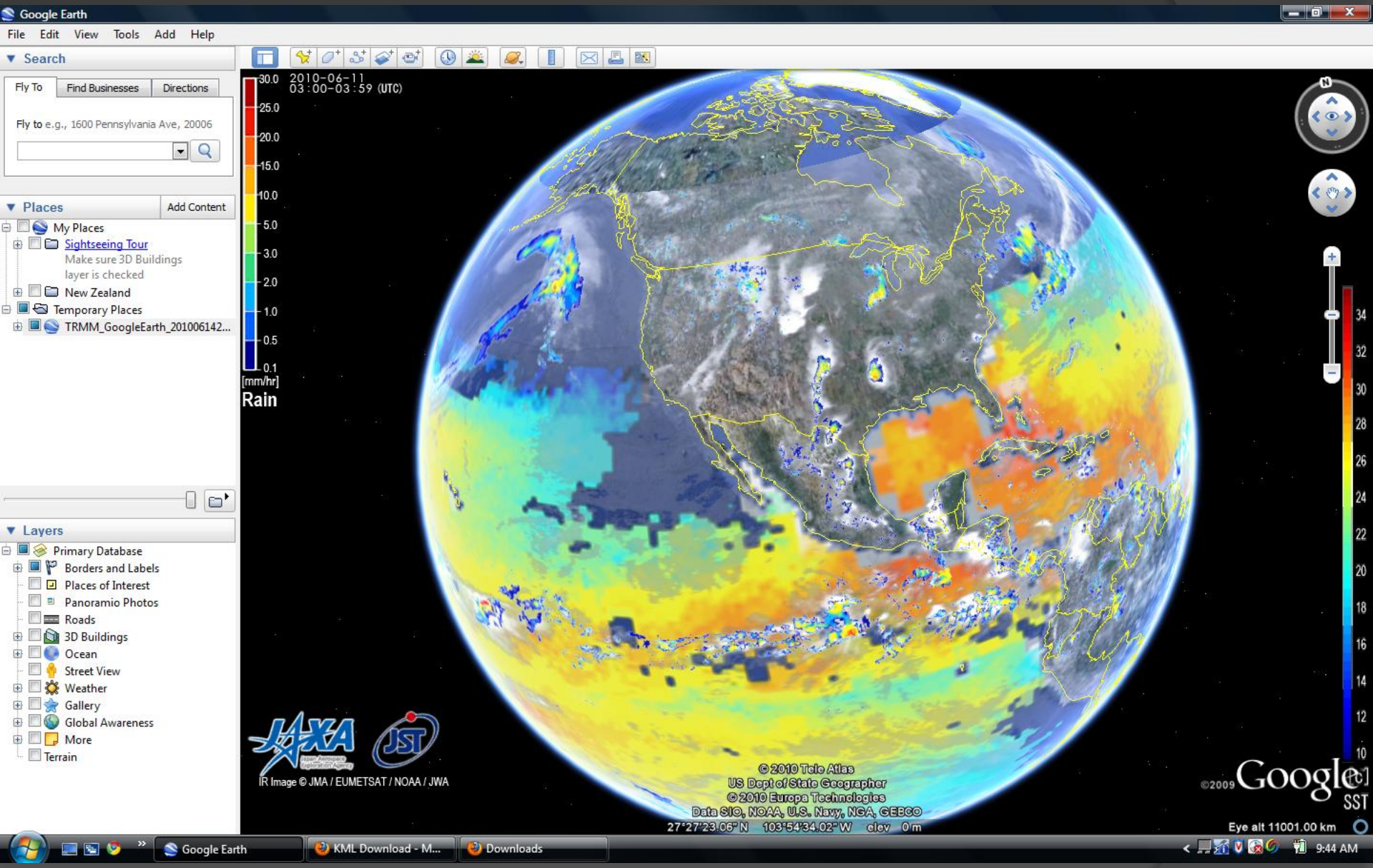
	Contents	this content is about: 1. Look for T. baby.	2. Forecast Route.	3. Observation
JAXA	TRMM real-time monitoring for tropical cyclones http://www.eorc.jaxa.jp/TRMM/NRTtyphoon/		●	●
JAXA	TRMM Sea Surface Temperature (SST) http://www.eorc.jaxa.jp/TRMM/data/monitoring/day_vrs/index_e.htm	●	●	
JAXA	Global Rainfall Map in Near Real Time http://sharaku.eorc.jaxa.jp/GSMaP/	●		
EXTERNAL	Radar and Precipitation Nowcast: Japan http://www.jma.go.jp/jma/indexe.html			●
EXTERNAL	Digital Typhoon: Typhoon Images and Information http://agora.ex.nii.ac.jp/digital-typhoon/			●
EXTERNAL	Google Earth Blog : Hurricanes - Live positions (Forecast route) http://www.gearthblog.com/		●	●

Generate KML - Download

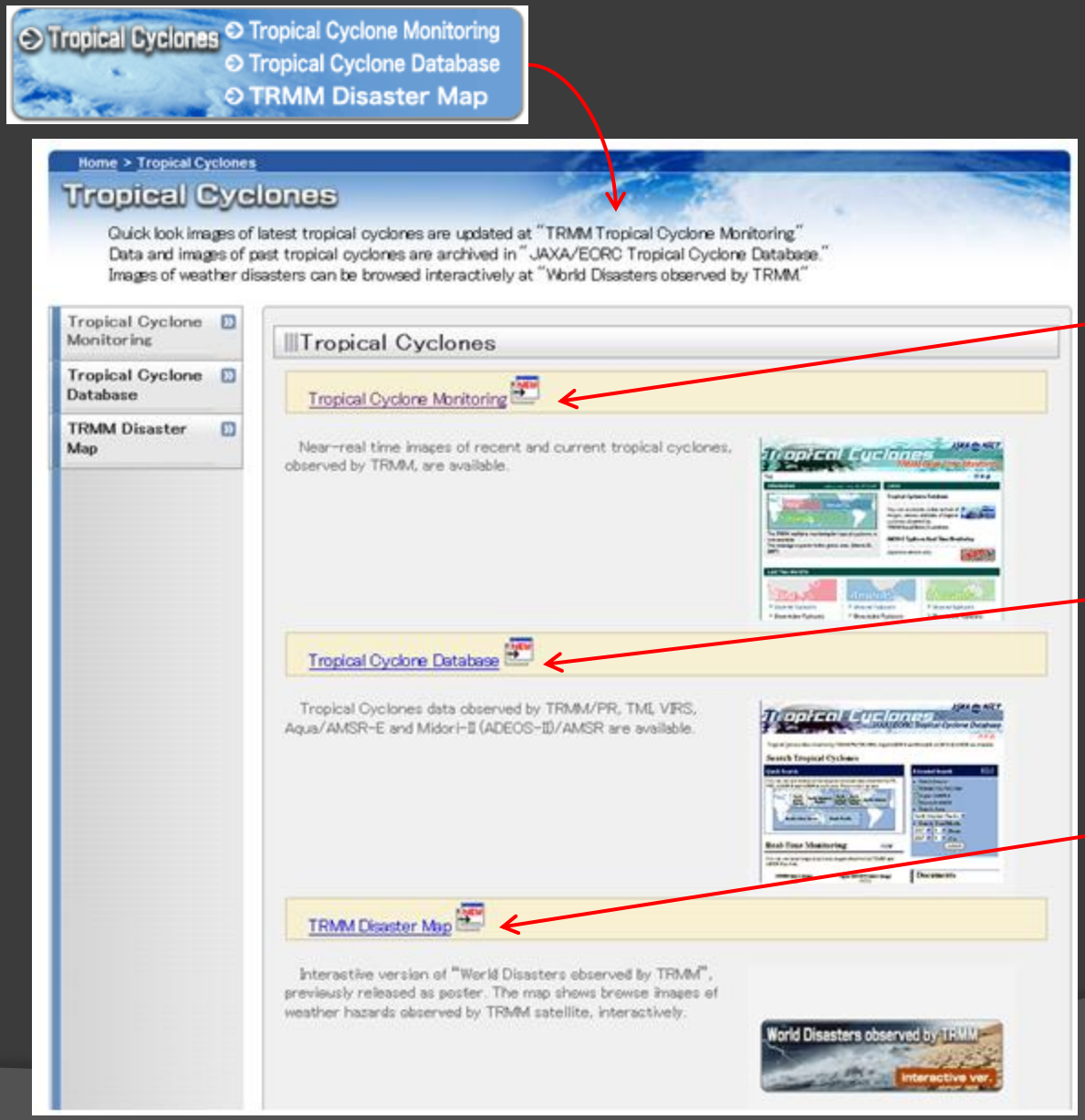
- Downloaded KML files will be connected to the latest information.
- For the information of updating, check the referred links for each KML files.
- If you failed to obtain a correct KML file, please try it again in a few minutes.

- TRMM Google Earth Lab is an efficient way of accessing near real time TRMM data in KML files for use in Google Earth
- By checking the box next to the data wanted, the user can chose data and then generate a near real time KML file, and view it in Google Earth
- The JAXA links include tropical cyclone monitoring, SSTs, and global rainfall

SST and Global Rainfall in Google Earth



TRMM – JAXA: Tropical Cyclones

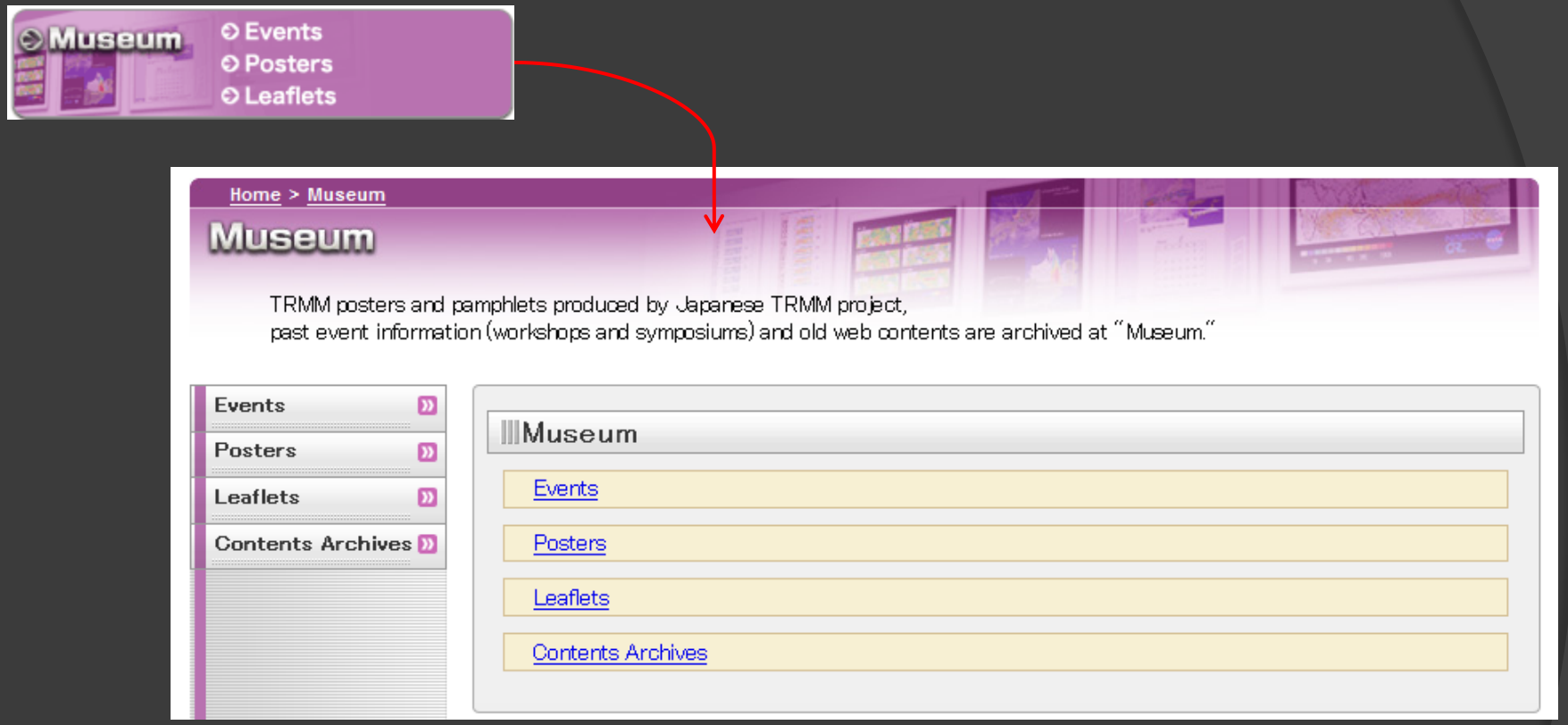


- Tropical Cyclones has links for tropical cyclone monitoring and database, as well as a disaster map
- The Monitoring link opens a new window where users can observe typhoons of the last two months over Asia, America, and Oceania
- The Database link opens a new window where users can search for tropical cyclones based on region, sensor, data, and name
- The Disaster map link opens an interactive global map where users can click around and gain information about past disasters

TRMM – JAXA: Reference Room

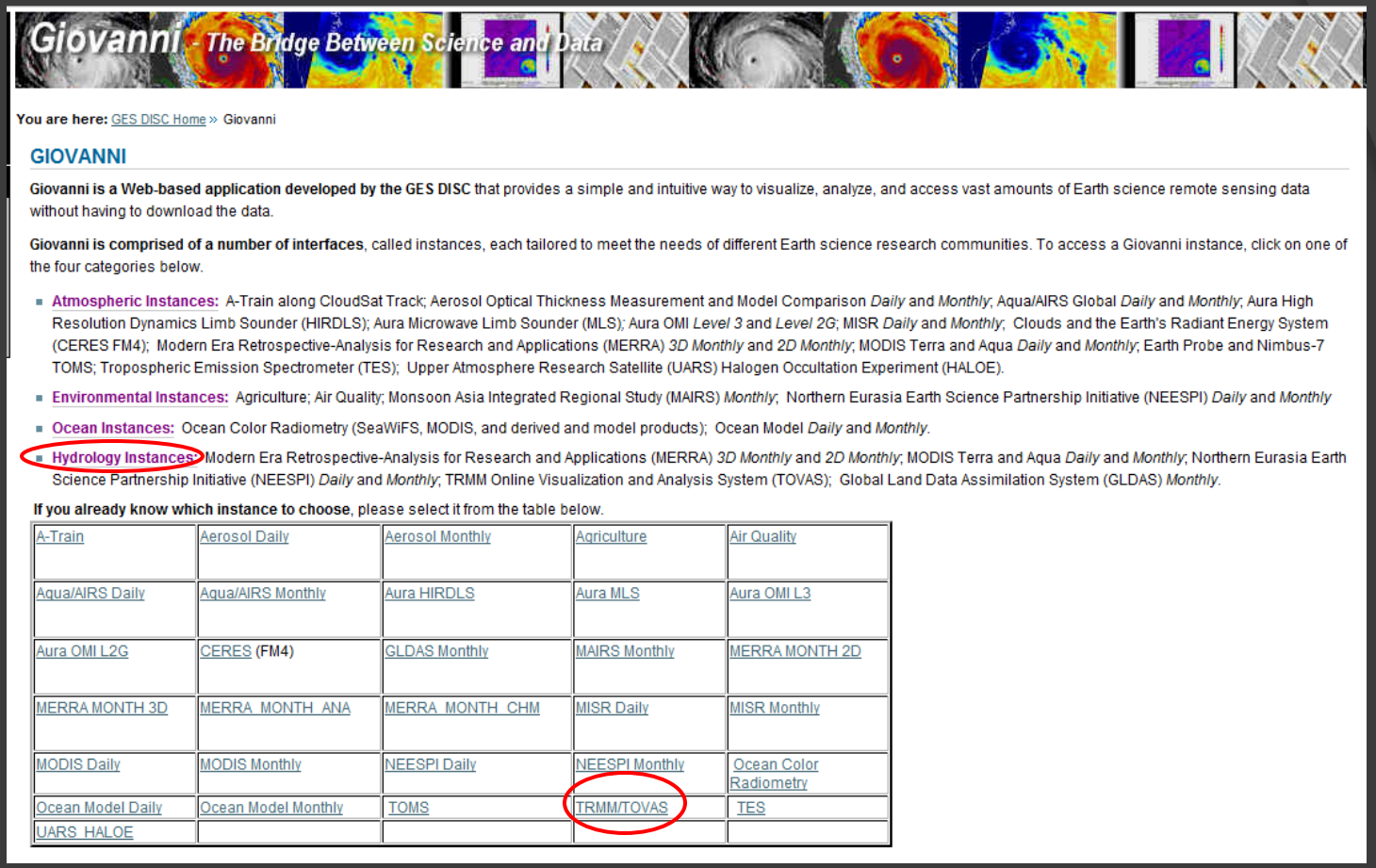
- Reference Room has links to more information about the satellite and its data
- Information about the satellite includes news and updates about its flight
- For a complete explanation of TRMM's products, click PR Algorithm and Product Information
- Users can access links to download data, read research announcements, or read FAQs

TRMM – JAXA: Museum



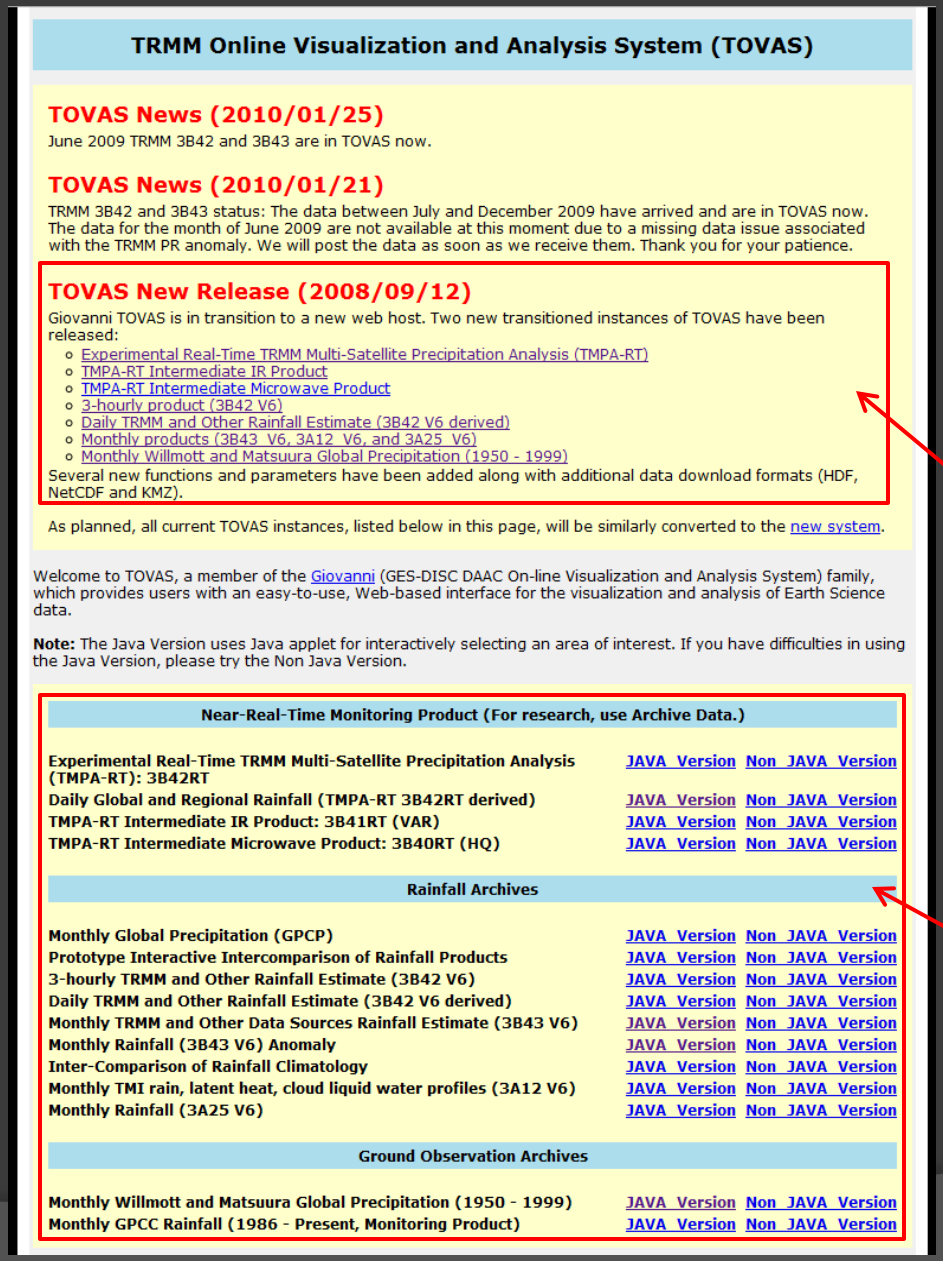
- Museum provides links to resources that were created using TRMM data
- There are links to previous events based on TRMM data, posters displaying TRMM analysis, and leaflets with examples of TRMM products

GIOVANNI



- http://disc.sci.gsfc.nasa.gov/giovanni
- Giovanni is an efficient and easy way to view and analyze data without downloading it
- Users can access TRMM data by either clicking “Hydrology Instances” and finding the TRMM link, or simply clicking the “TRMM/TOVAS” link in the grid

GIOVANNI



TRMM Online Visualization and Analysis System (TOVAS)

TOVAS News (2010/01/25)

June 2009 TRMM 3B42 and 3B43 are in TOVAS now.

TOVAS News (2010/01/21)

TRMM 3B42 and 3B43 status: The data between July and December 2009 have arrived and are in TOVAS now. The data for the month of June 2009 are not available at this moment due to a missing data issue associated with the TRMM PR anomaly. We will post the data as soon as we receive them. Thank you for your patience.

TOVAS New Release (2008/09/12)

Giovanni TOVAS is in transition to a new web host. Two new transitioned instances of TOVAS have been released:

- Experimental Real-Time TRMM Multi-Satellite Precipitation Analysis (TMPA-RT)
- TMPA-RT Intermediate IR Product
- TMPA-RT Intermediate Microwave Product
- 3-hourly product (3B42 V6)
- Daily TRMM and Other Rainfall Estimate (3B42 V6 derived)
- Monthly products (3B43_V6, 3A12_V6, and 3A25_V6)
- Monthly Willmott and Matsuura Global Precipitation (1950 - 1999)

Several new functions and parameters have been added along with additional data download formats (HDF, NetCDF and KMZ).

As planned, all current TOVAS instances, listed below in this page, will be similarly converted to the new system.

Welcome to TOVAS, a member of the Giovanni (GES-DISC DAAC On-line Visualization and Analysis System) family, which provides users with an easy-to-use, Web-based interface for the visualization and analysis of Earth Science data.

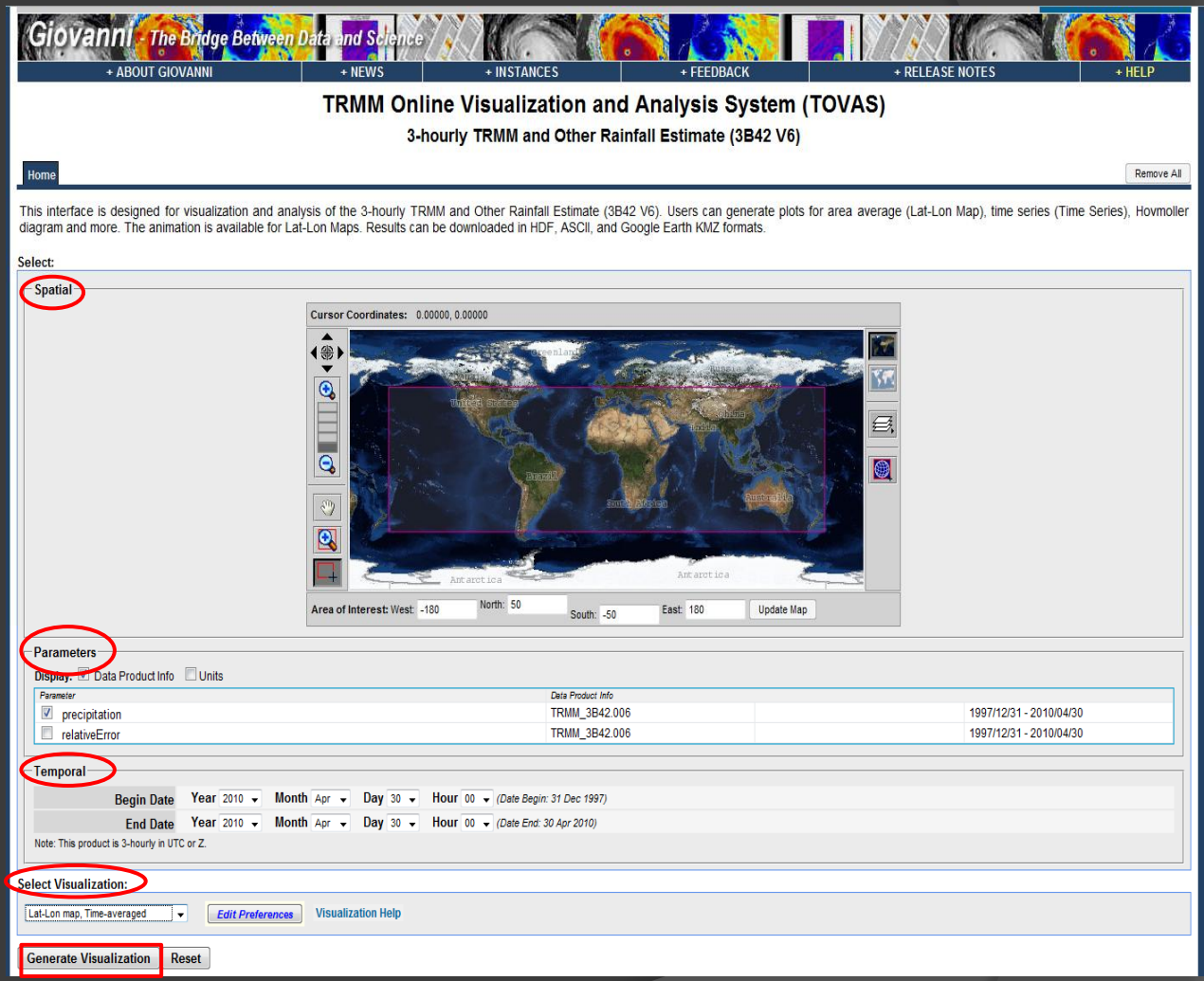
Note: The Java Version uses Java applet for interactively selecting an area of interest. If you have difficulties in using the Java Version, please try the Non Java Version.

Near-Real-Time Monitoring Product (For research, use Archive Data.)		
Experimental Real-Time TRMM Multi-Satellite Precipitation Analysis (TMPA-RT): 3B42RT	JAVA Version	Non JAVA Version
Daily Global and Regional Rainfall (TMPA-RT 3B42RT derived)	JAVA Version	Non JAVA Version
TMPA-RT Intermediate IR Product: 3B41RT (VAR)	JAVA Version	Non JAVA Version
TMPA-RT Intermediate Microwave Product: 3B40RT (HQ)	JAVA Version	Non JAVA Version
Rainfall Archives		
Monthly Global Precipitation (GPCP)	JAVA Version	Non JAVA Version
Prototype Interactive Intercomparison of Rainfall Products	JAVA Version	Non JAVA Version
3-hourly TRMM and Other Rainfall Estimate (3B42 V6)	JAVA Version	Non JAVA Version
Daily TRMM and Other Rainfall Estimate (3B42 V6 derived)	JAVA Version	Non JAVA Version
Monthly TRMM and Other Data Sources Rainfall Estimate (3B43 V6)	JAVA Version	Non JAVA Version
Monthly Rainfall (3B43 V6) Anomaly	JAVA Version	Non JAVA Version
Inter-Comparison of Rainfall Climatology	JAVA Version	Non JAVA Version
Monthly TMI rain, latent heat, cloud liquid water profiles (3A12 V6)	JAVA Version	Non JAVA Version
Monthly Rainfall (3A25 V6)	JAVA Version	Non JAVA Version
Ground Observation Archives		
Monthly Willmott and Matsuura Global Precipitation (1950 - 1999)	JAVA Version	Non JAVA Version
Monthly GPCC Rainfall (1986 - Present, Monitoring Product)	JAVA Version	Non JAVA Version

- Here, users can access tons of TRMM data
- The TOVAS New Release links connect to the newer version of TOVAS for easy-to-use visualization
- The second section has links to the older version, however the data is still up-to-date

GIOVANNI

- Select one of the products for analysis from the top section
- Now the user can select spatial location, parameters, date and time, and the type of visualization wanted
  - Visualizations include lat/lon maps, Hovmoller diagrams, scatter plots, time series, correlation maps, overlays, and animations
- Click “Generate Visualization” to submit



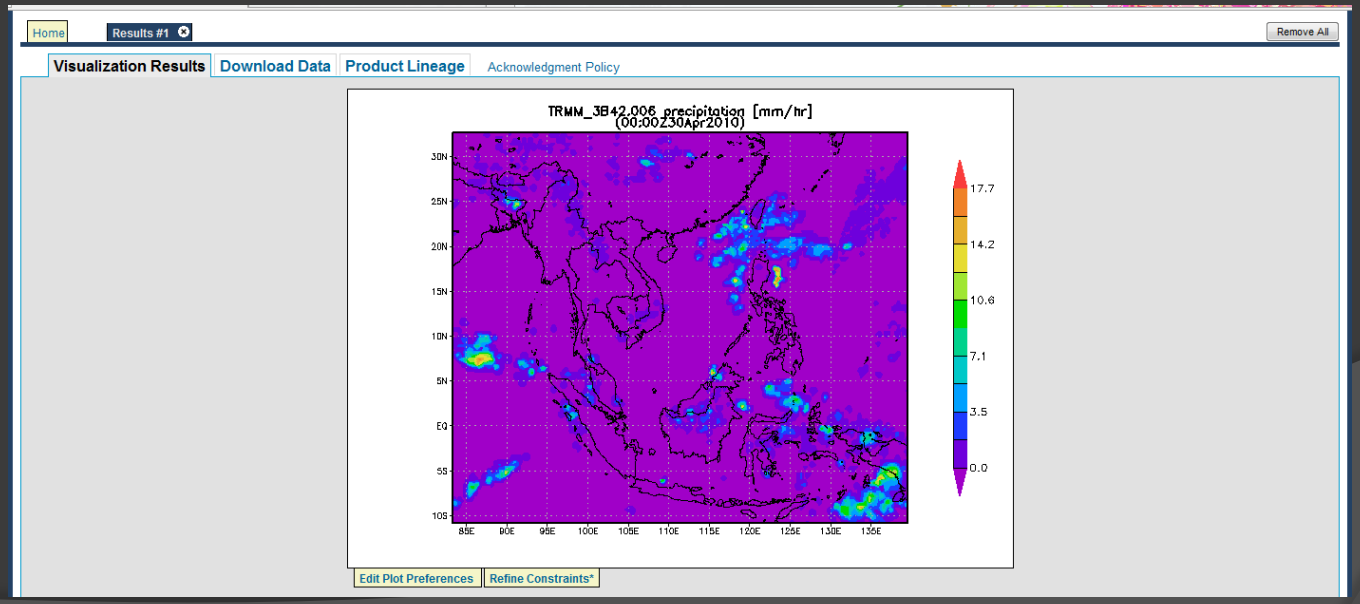
GIOVANNI

Home | Results #1 | Remove All

Execution Status

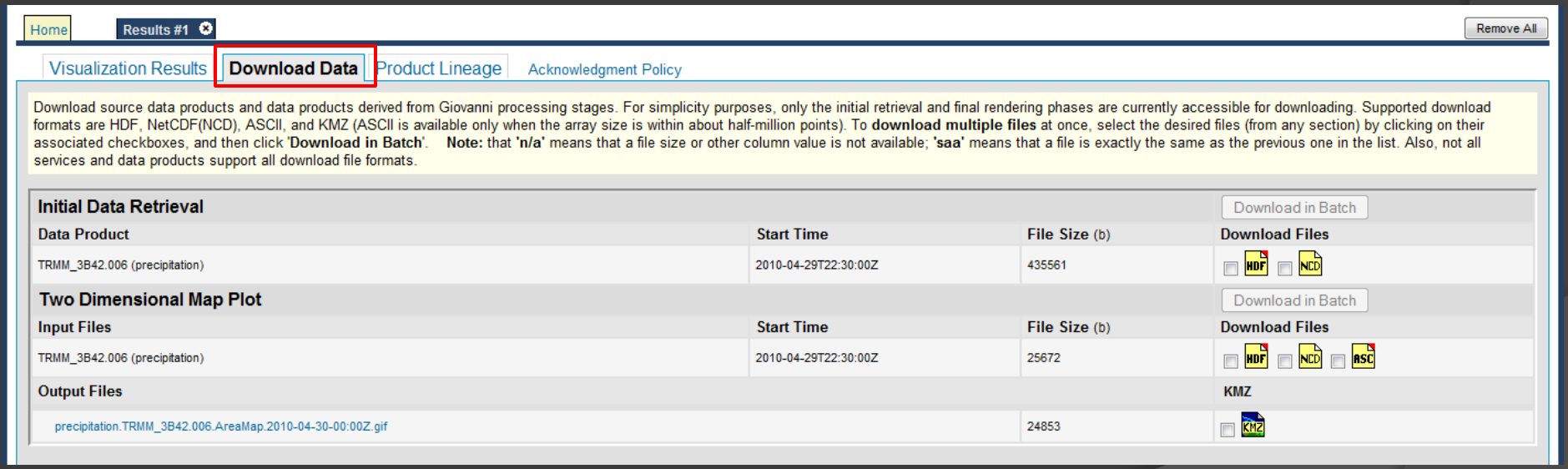
StepNumber	Operation	Status	StartTime	CompletionTime
1	Data Fetching	COMPLETE	Tue Jun 8 21:21:52 GMT 2010	Tue Jun 8 21:21:54 GMT 2010
2	Preprocessor	COMPLETE	Tue Jun 8 21:21:54 GMT 2010	Tue Jun 8 21:21:55 GMT 2010
3	Parameter Masking	COMPLETE	Tue Jun 8 21:21:55 GMT 2010	Tue Jun 8 21:21:56 GMT 2010
4	Grid Subsetter	COMPLETE	Tue Jun 8 21:21:56 GMT 2010	Tue Jun 8 21:21:56 GMT 2010
5	Anomaly	COMPLETE	Tue Jun 8 21:21:57 GMT 2010	Tue Jun 8 21:21:57 GMT 2010
6	Time Averaging	COMPLETE	Tue Jun 8 21:21:57 GMT 2010	Tue Jun 8 21:21:58 GMT 2010
7	Dimension Averaging	COMPLETE	Tue Jun 8 21:21:58 GMT 2010	Tue Jun 8 21:21:59 GMT 2010
8	Two Dimensional Map Plot	Active	Tue Jun 8 21:21:59 GMT 2010	

- Once the user clicks “Generate Visualization”, the window will have a table of actions that the computer is performing
- When it is complete, the image will appear

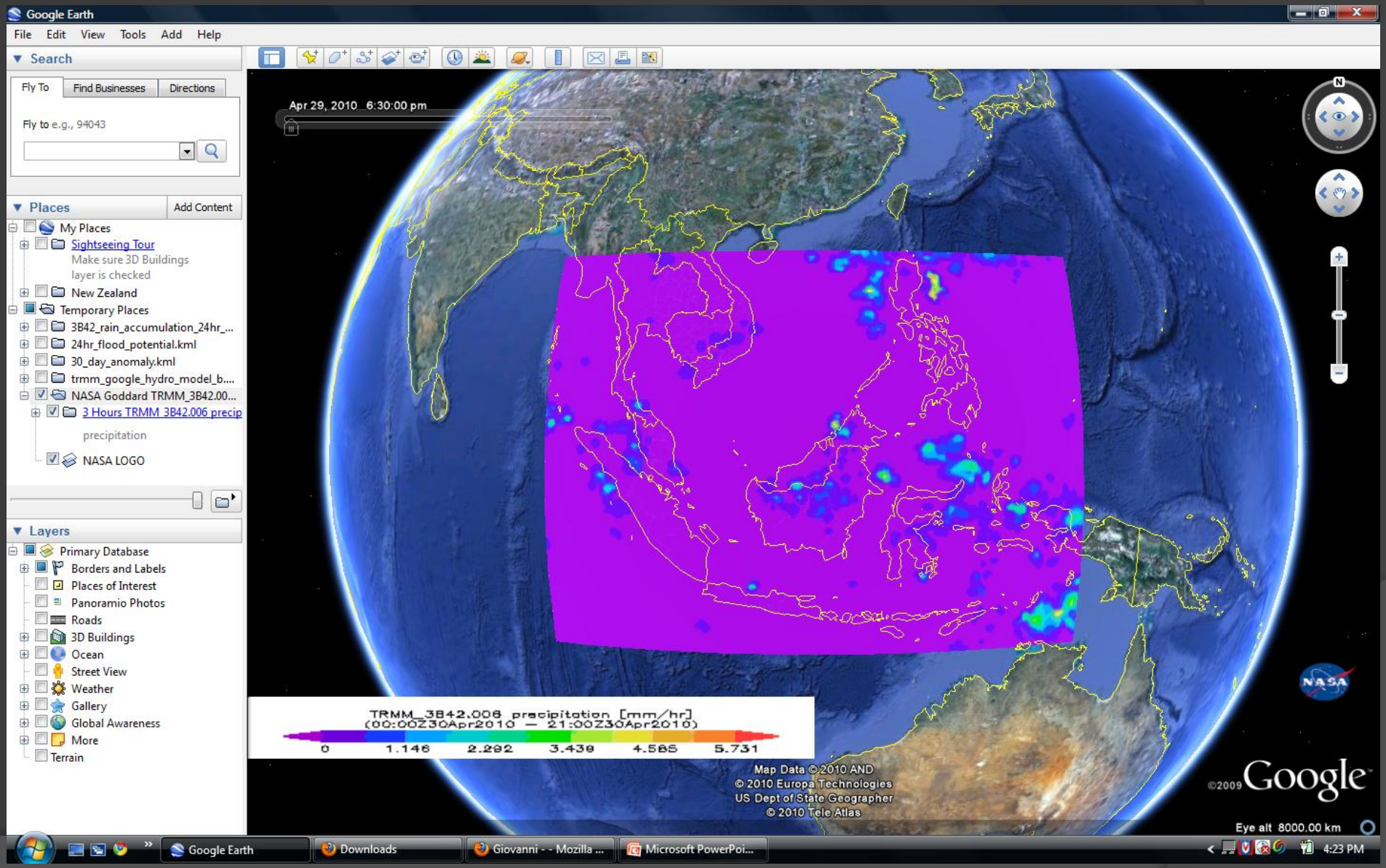


GIOVANNI

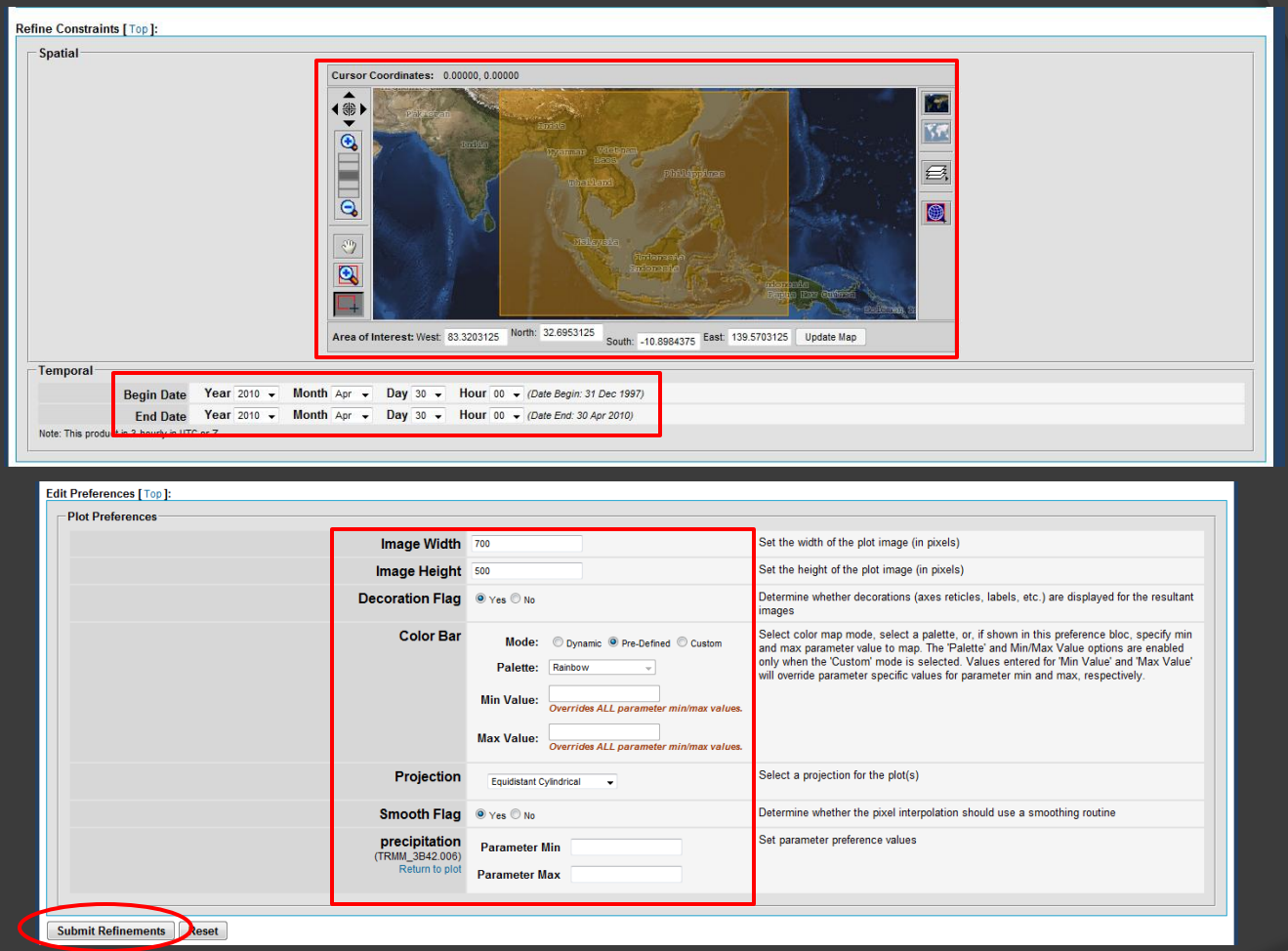
- Above the image, the user has the option to Download the data
- The files can be downloaded individually as HDF, NCD, or ASC, or as the final product as KMZ (for Google Earth) files



GIOVANNI Image in Google Earth



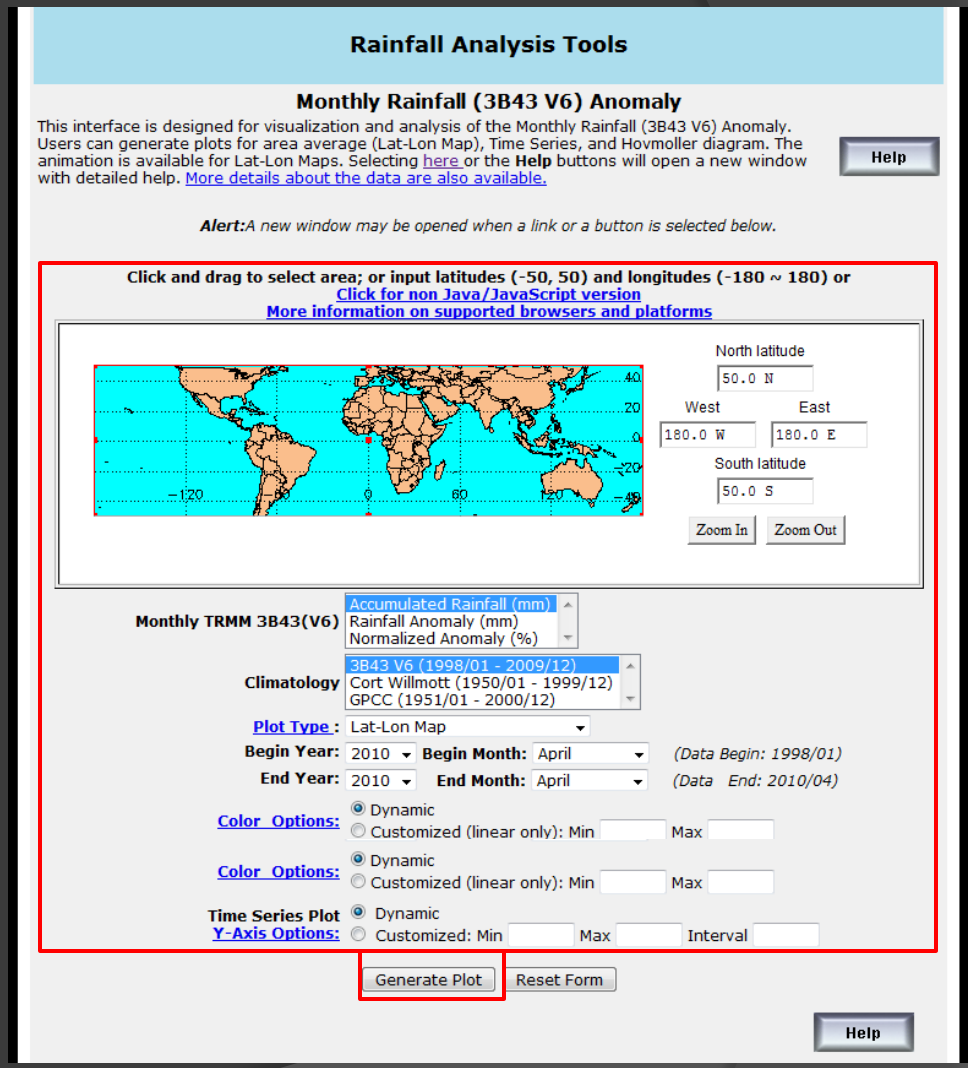
GIOVANNI



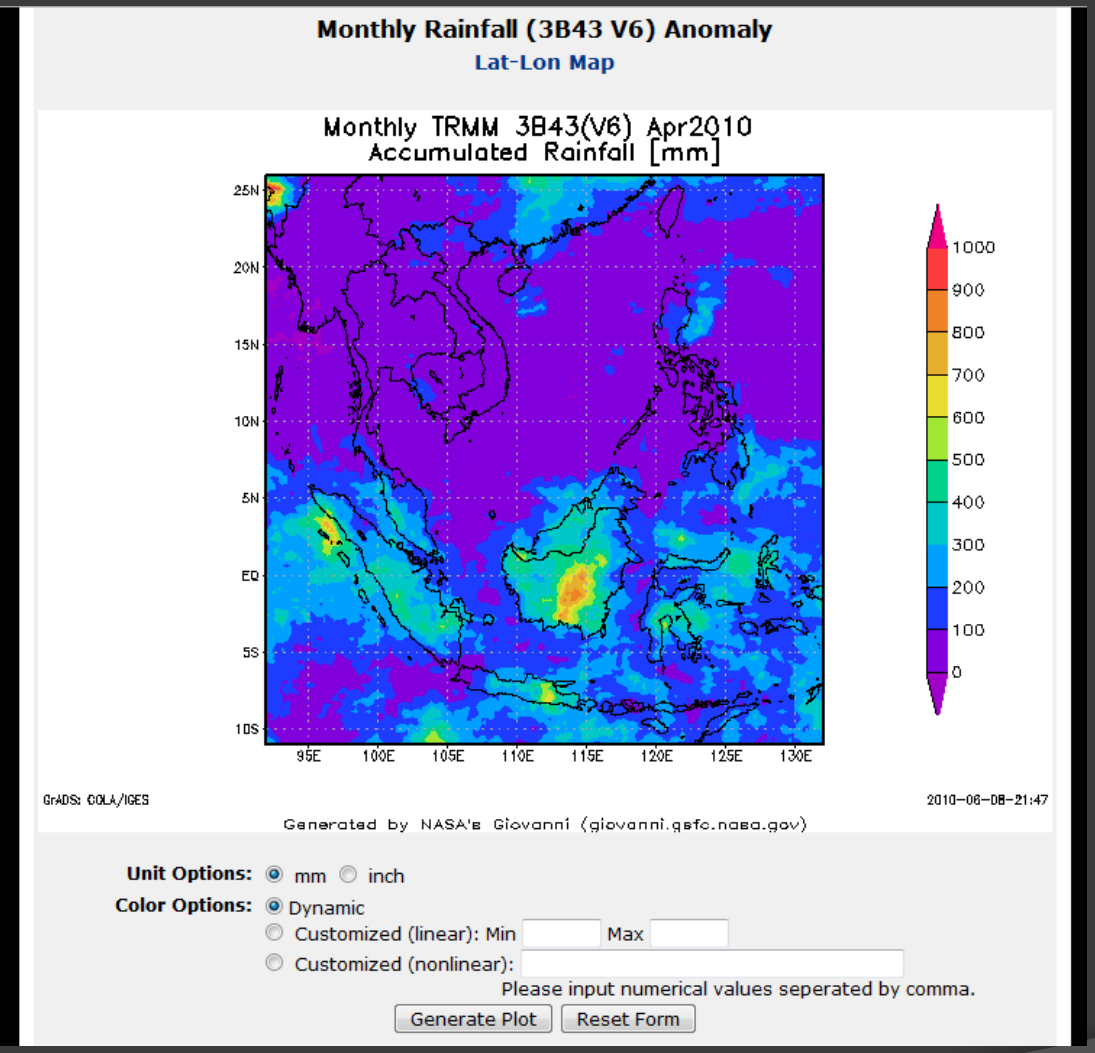
- Beneath the image, the user can refine constraints and edit preferences, including max and min value, color bar palette, projection type, and size

GIOVANNI

- To use the older version of data, there is a JAVA version and a non-JAVA version
- The options for creating the visualizations are the same: select area, parameters, plot type, date, and other options
- “Generate Plot” will create the visualization

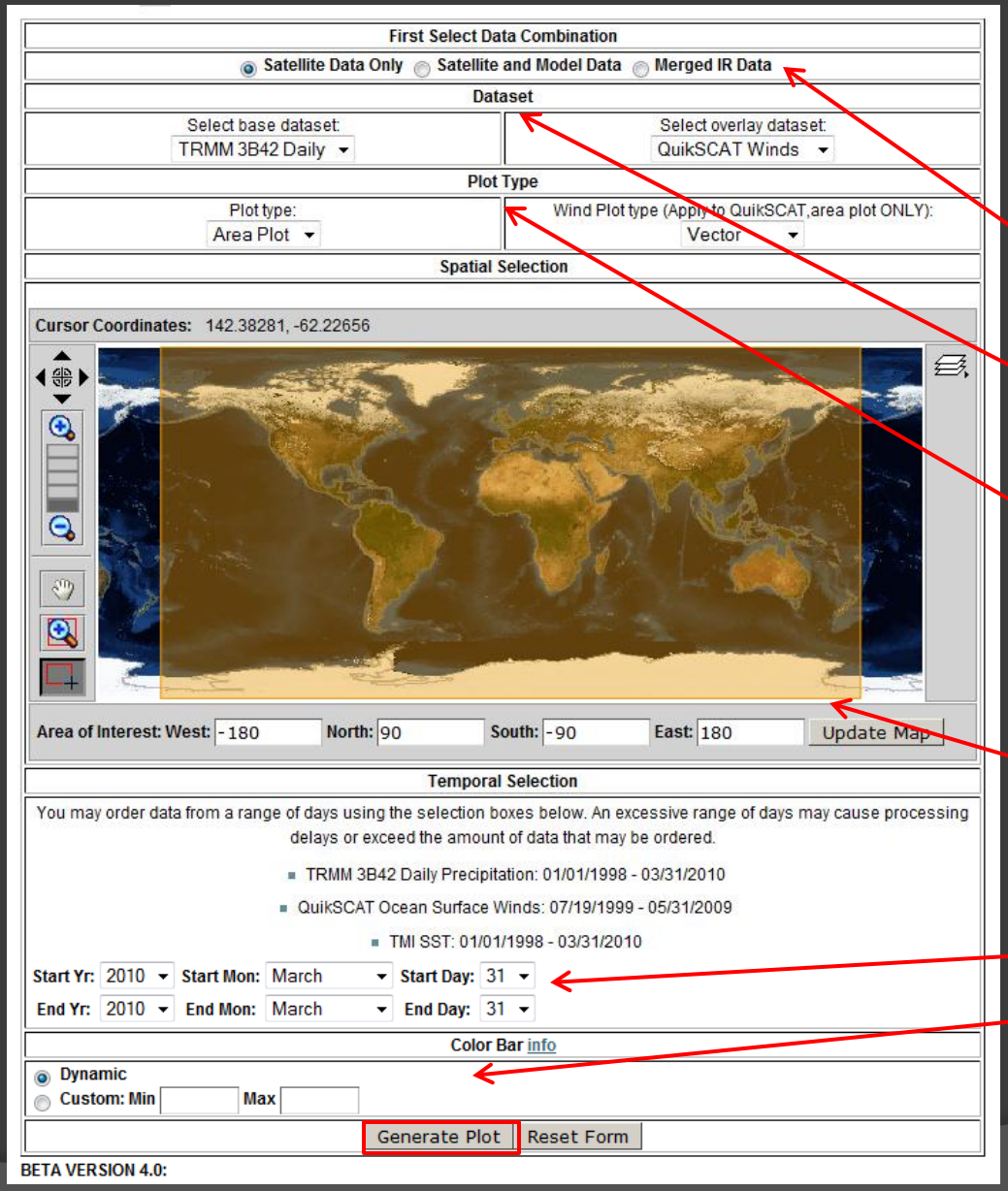


GIOVANNI



- The user will end up with a similar image, with options to re-generate the plot

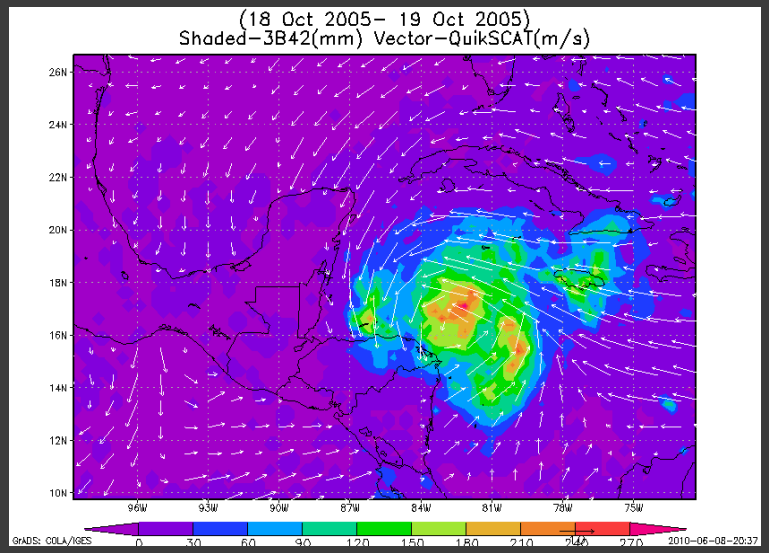
Hurricane Analysis Tool

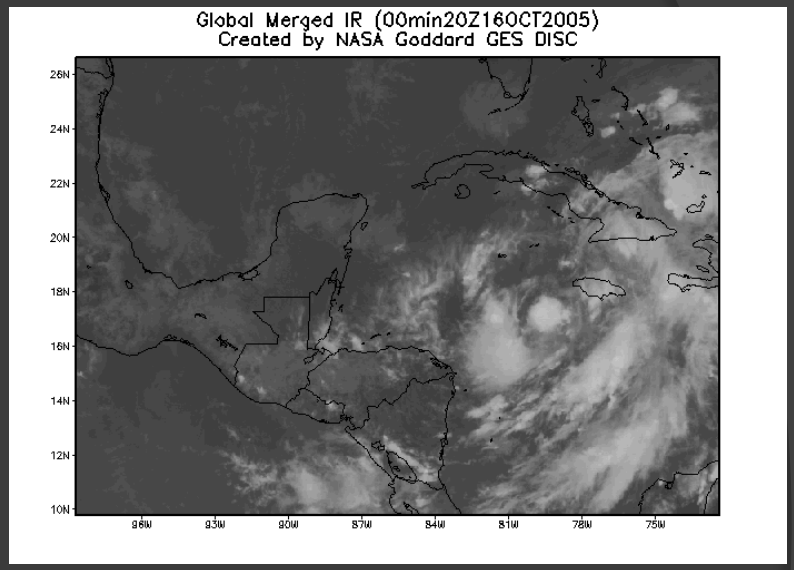


- http://disc.sci.gsfc.nasa.gov/daac-bin/hurricane_data_analysis_tool.pl
- User can select the type of data wanted
- Two Datasets (TRMM daily rainfall, SSTs, Winds)
- Type of plot (area or time; for winds vector or streamline)
- Area of interest by click and drag or entering lat/lon coordinates
- Date
- Customize color bar
- Click “Generate Plot” to obtain the map

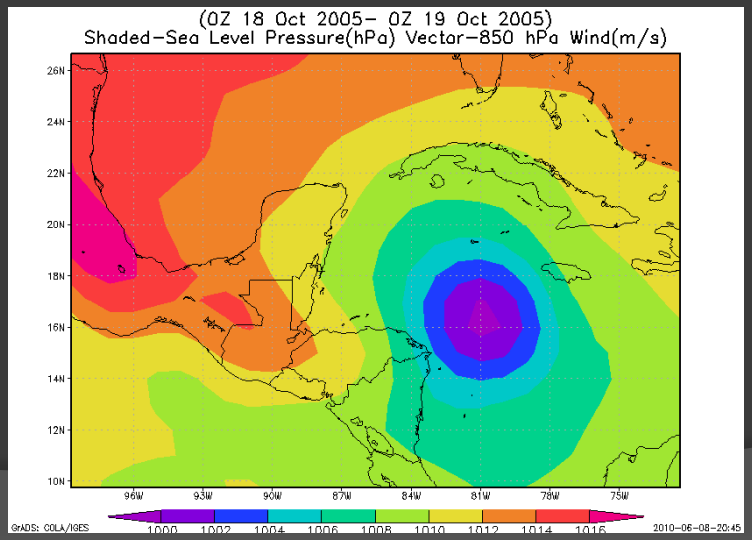
Hurricane Analysis Tool

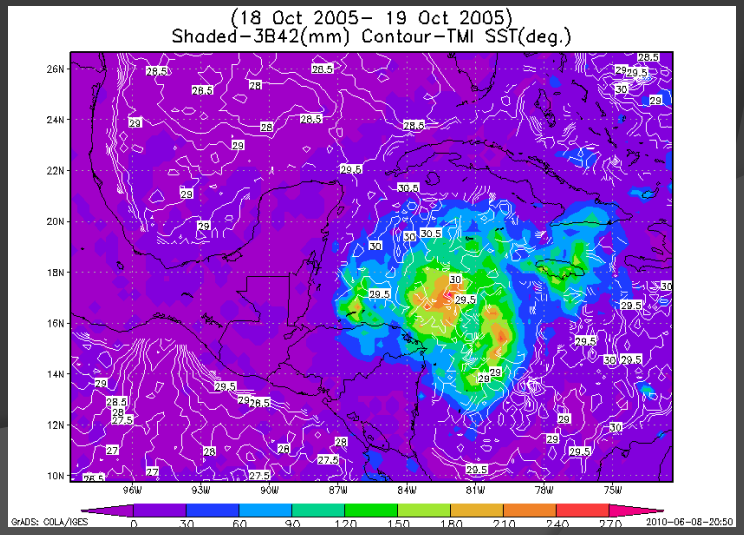
- The user will end up with something like this:





Images of Hurricane Wilma, October 2005





SERVIR

Select language

Select region to explore

- http://www.servir.net/
- SERVIR is a "Regional Visualization and Monitoring System that integrates earth observations (e.g. satellite imagery) and forecast models together with in situ data and knowledge for timely decision- making to benefit society."
- SERVIR focuses on Mesoamerica and Africa, both developing areas
- Using the resources in SERVIR, the user can observe the threat of natural disasters in the areas, including floods, fires, earthquakes, volcanoes, and tropical storms

SERVIR

- Clicking on a portal brings the user to an interactive, animated map of the selected area
- This map shows current precipitation, earthquakes, fires, volcano alerts and GDACS alerts

SERVIR

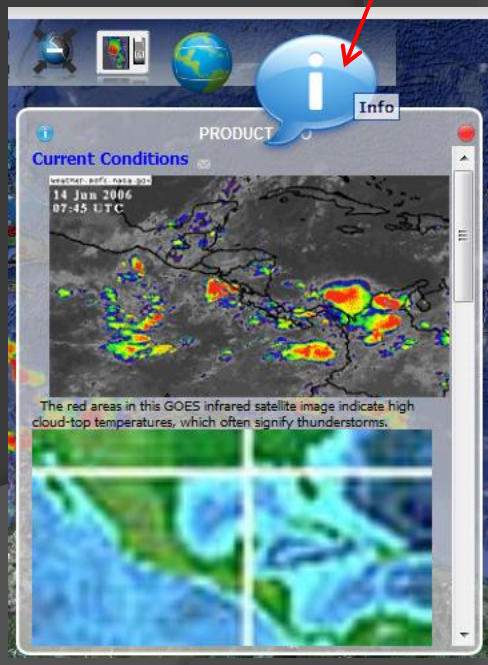
Change map type

Zoom

Turn weather on/off

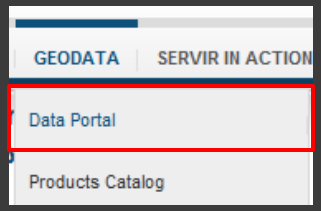
Restart map

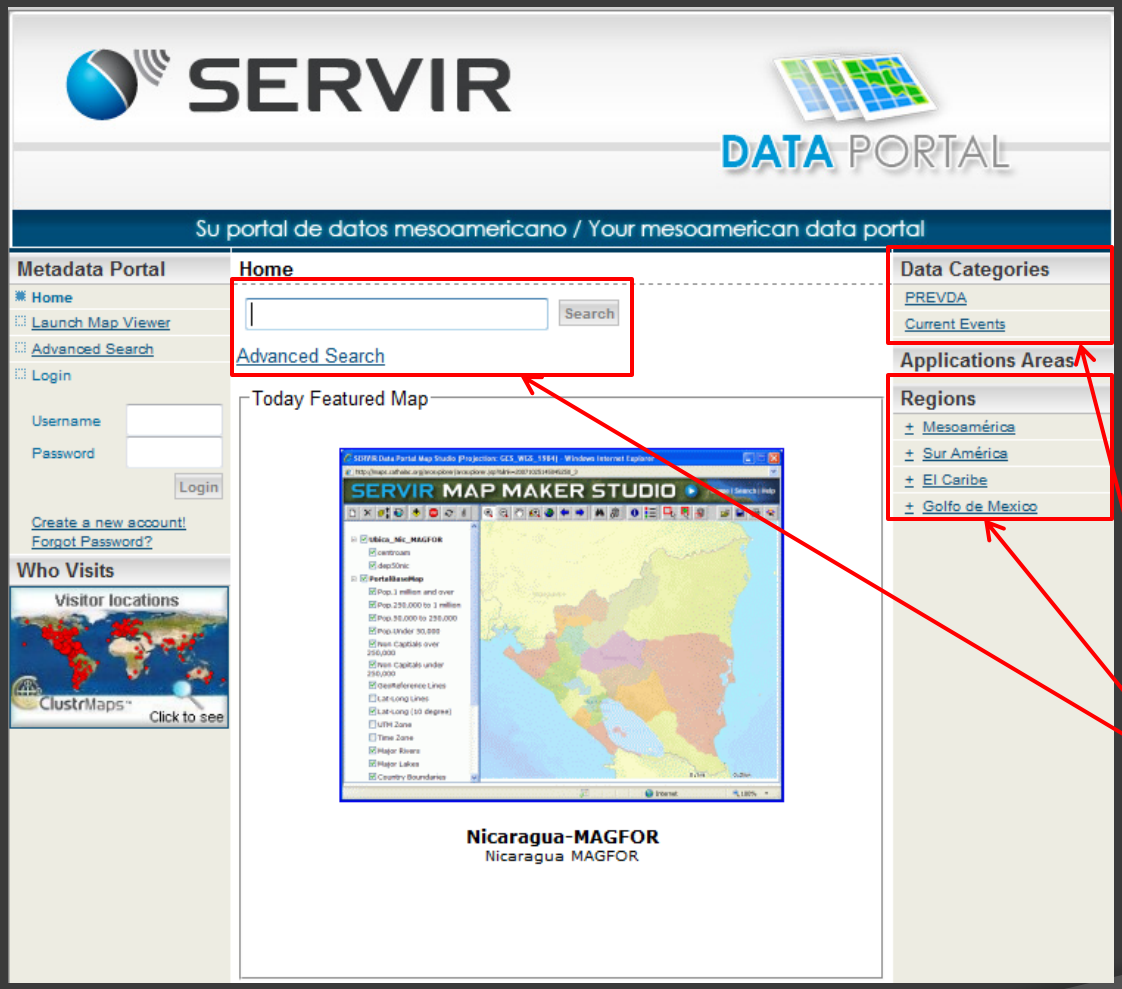
Info



- Click the controls to change the type of map displayed, zoom, turn precipitation on/off, restart, or get info
- Click on disasters to get information on them

SERVIR

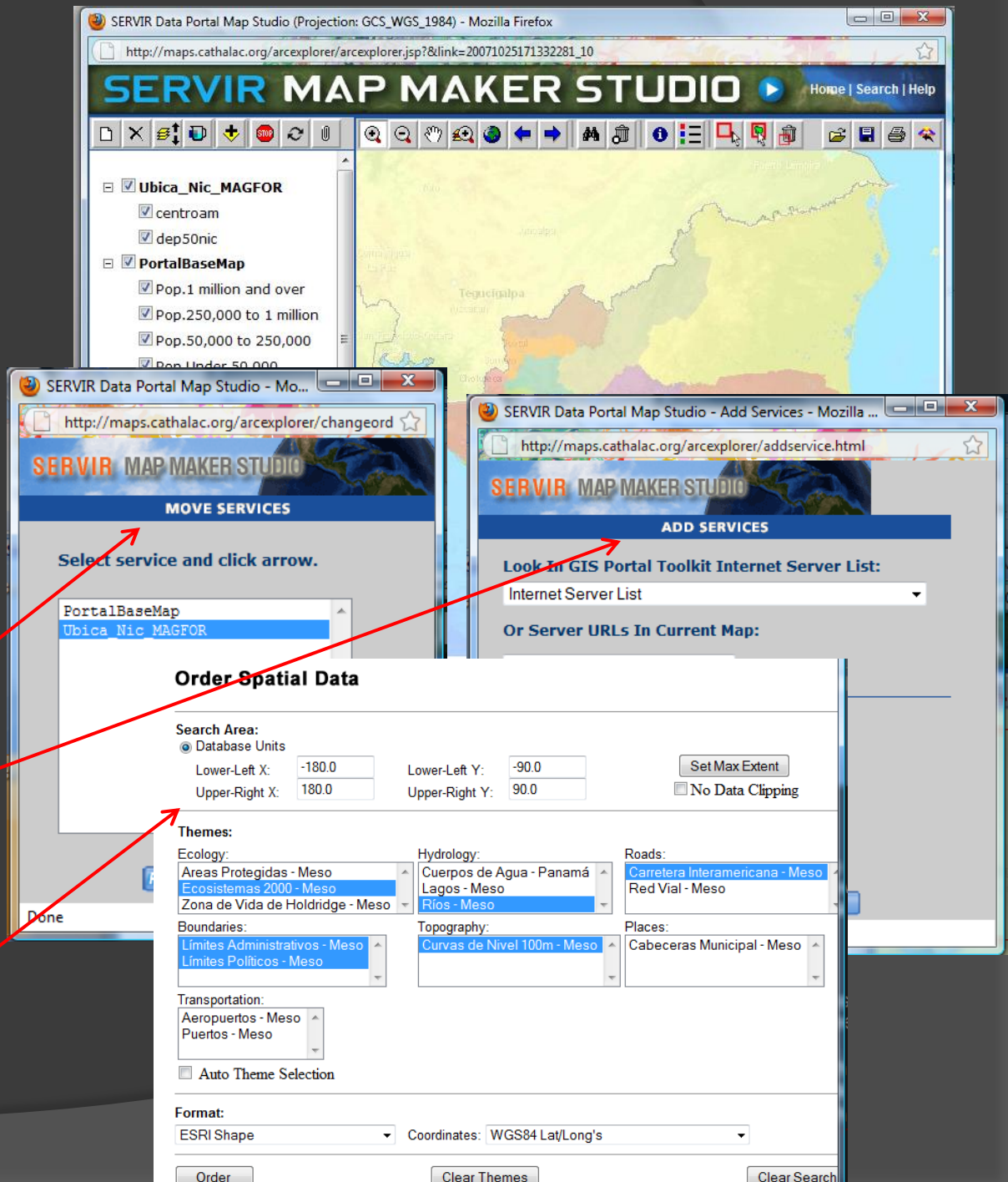




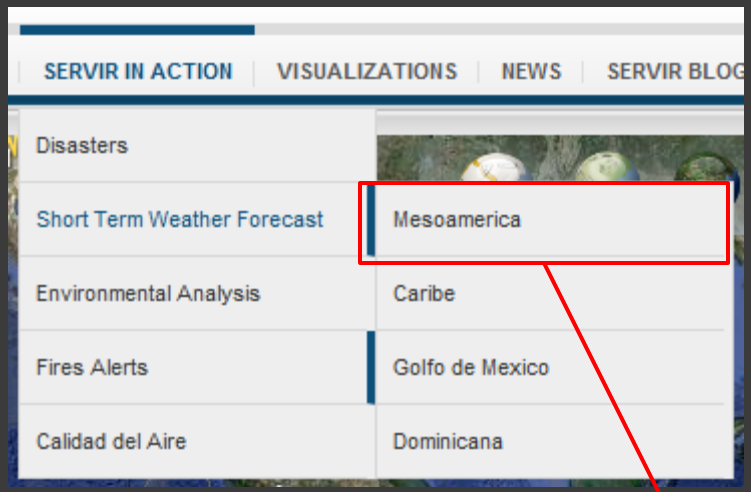
- Under the GEODATA tab, there are two links: Data Portal and Products Catalog
- Data Portal brings the user to a page where they can search for data and create a map
- The user can search by category, region, or keyword

SERVIR

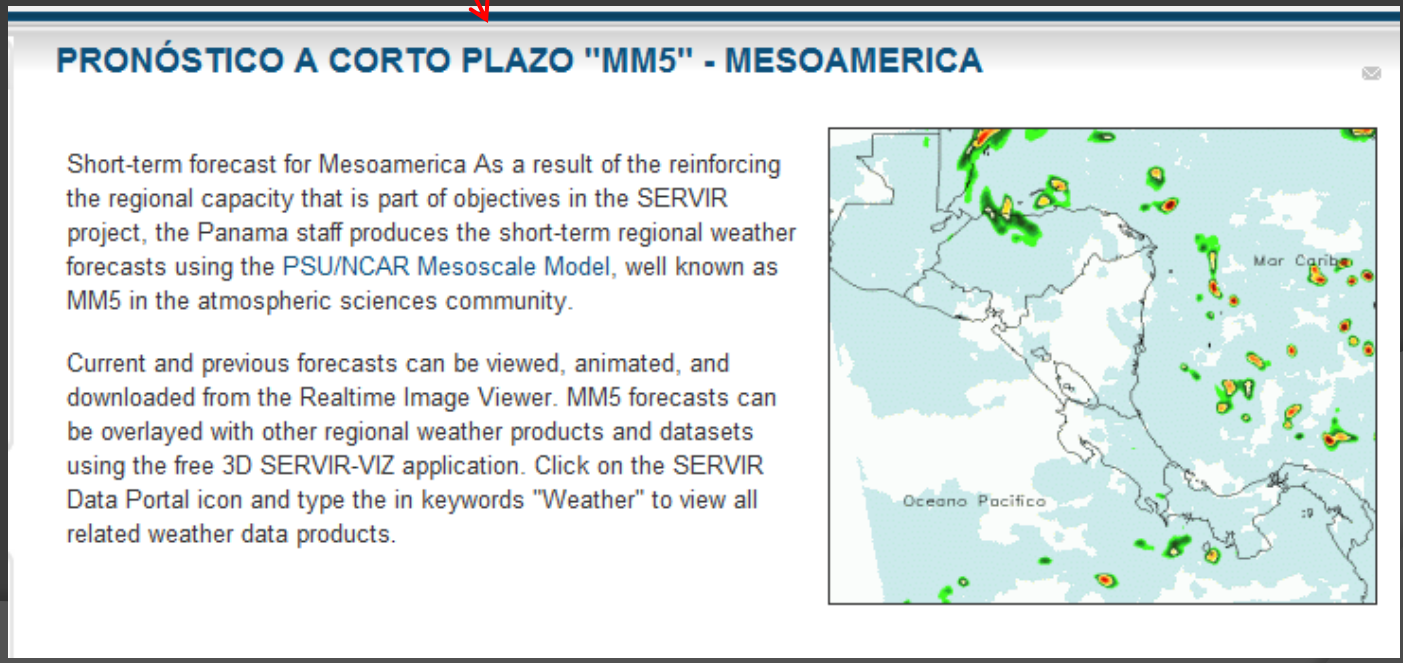
- Launching the Map Viewer opens a new window with the Map Maker Studio
- The studio is very similar to GIS
- Rollover the buttons on the toolbar to see what they do
- Clicking allows the user to move layers
- Clicking allows the user to add layers accessible from credible websites
- Clicking allows the user to download data



SERVIR

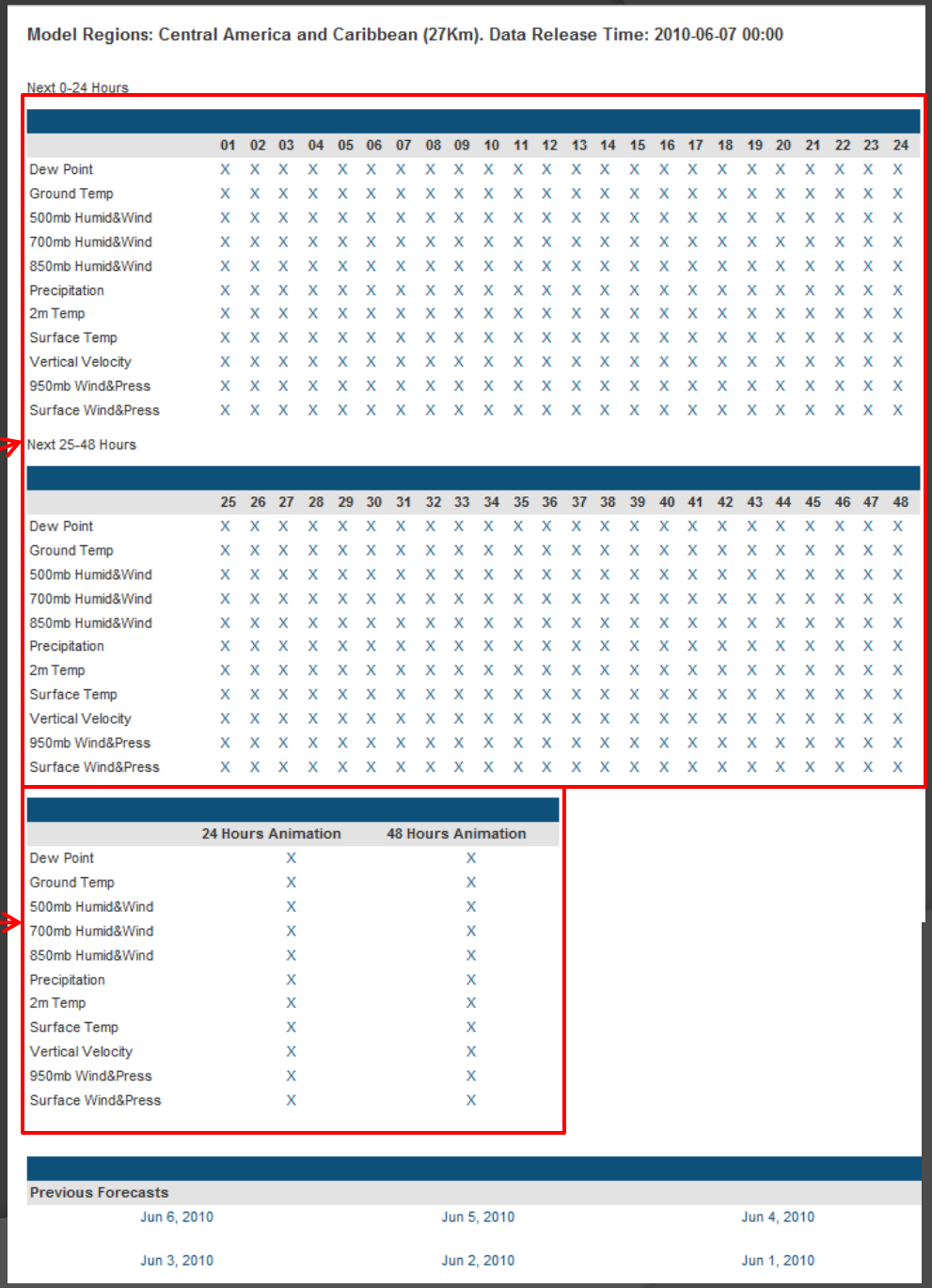


- Clicking on the SERVIR IN ACTION tab, users can view information on disasters, forecasts, environmental analysis, fire alerts, and air quality
- Under the Short Term Weather Forecast tab, users can access forecasts for specific regions



SERVIR

- Scrolling down, users can look at maps of forecasts for that area in 11 different categories, hourly for 48 hours
- There are also animations of the data in 24 hour or 48 hour increments



Model Regions: Central America and Caribbean (27Km). Data Release Time: 2010-06-07 00:00

Next 0-24 Hours

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Dew Point	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ground Temp	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500mb Humid&Wind	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
700mb Humid&Wind	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
850mb Humid&Wind	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Precipitation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2m Temp	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Surface Temp	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Vertical Velocity	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
950mb Wind&Press	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Surface Wind&Press	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Next 25-48 Hours

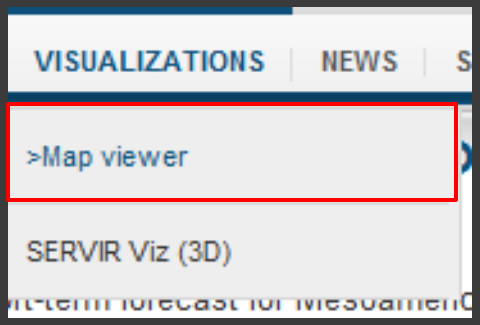
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Dew Point	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ground Temp	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
500mb Humid&Wind	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
700mb Humid&Wind	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
850mb Humid&Wind	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Precipitation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2m Temp	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Surface Temp	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Vertical Velocity	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
950mb Wind&Press	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Surface Wind&Press	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

	24 Hours Animation	48 Hours Animation
Dew Point	X	X
Ground Temp	X	X
500mb Humid&Wind	X	X
700mb Humid&Wind	X	X
850mb Humid&Wind	X	X
Precipitation	X	X
2m Temp	X	X
Surface Temp	X	X
Vertical Velocity	X	X
950mb Wind&Press	X	X
Surface Wind&Press	X	X

Previous Forecasts

Jun 6, 2010	Jun 5, 2010	Jun 4, 2010
Jun 3, 2010	Jun 2, 2010	Jun 1, 2010

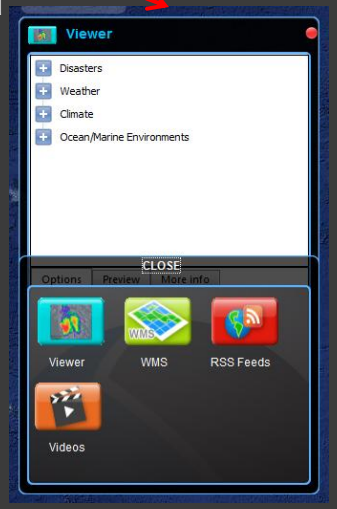
SERVIR

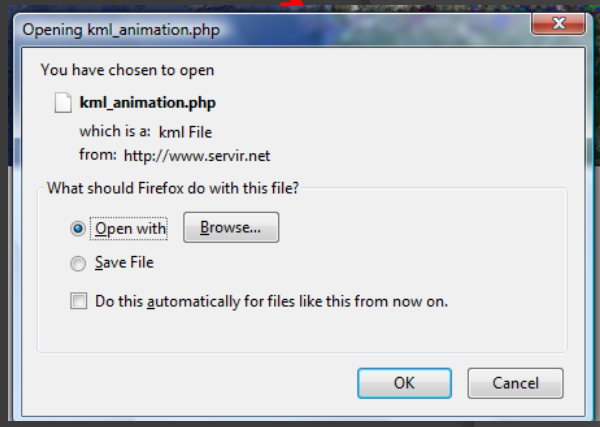


Menu

Other map types

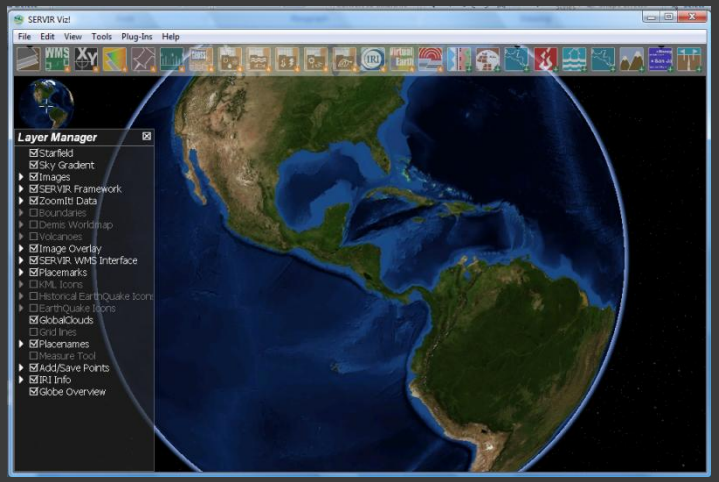
KML

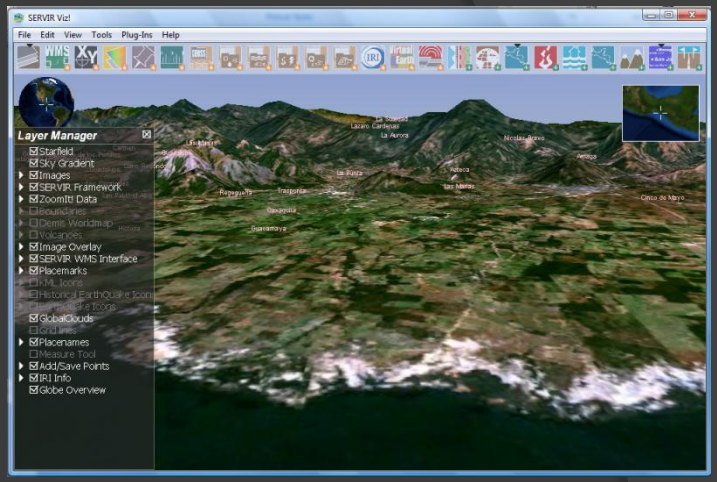




- Clicking on the VISUALIZATIONS tab, there are two options: Map Viewer and SERVIR Viz
- Map Viewer opens a new window, with an interactive animated map similar to the one on the portal homepage
- This map has more options:
  - Menu – with the ability to search and add layers of different data
  - KML – export the map to Google Earth

SERVIR





- SERVIR Viz is a free, downloadable program that is a modification of NASA World Wind software
- The program looks like Google Earth, but if specific to Mesoamerica and Africa
- It can be downloaded by clicking the tab “SERVIR Viz” under VISUALIZATIONS and clicking the download link on that page
- SERVIR Viz includes the same data and options as the Map Viewer, it is simply a 3-D view

SERVIR VIZ Toolbar Icon Explanations

Layer Manager - Turns the Layer Manager on and off in the SERVIR-Viz window. The Layer Manager contains a number of data layers and other features that can be turned on and off.

SERVIR WMS Interface - Allows SERVIR-Viz to browse SERVIR WMS server archives and their contents.

Zoom to Location - Zooms SERVIR-Viz to a Latitude and Longitude location based on user input.

Image Overlay - Allows user to load images including 2D maps onto the SERVIR-Viz terrain.

Placemarks - Allows user to mark places of interest on the SERVIR-Viz terrain and export the locations to a Google Earth .kmz file.

Measure Tool - Allows user to measure a point to point distance in meters and provides the bearing in degrees.

GEOSS Decision Support - Provides the user with Global Earth Observation System of Systems (GEOSS) data to look at together and study their interactions on the SERVIR-Viz terrain.

GEOSS Weather - Provides a direct link to GEOSS weather data to be viewed in SERVIR-Viz.

GEOSS Ocean/Marine Environments - Provides a direct link to GEOSS ocean and marine environment data to be viewed in SERVIR-Viz.

GEOSS Disasters - Provides a direct link to GEOSS disaster data to be viewed in SERVIR-Viz.

GEOSS Climate - Provides a direct link to GEOSS climate data to be viewed in SERVIR-Viz.

GEOSS Ecology - Provides a direct link to GEOSS ecology data to be viewed in SERVIR-Viz.

Climate Mapper - The Climate Mapper was developed for SERVIR-Viz to give project designers access to historical weather data as well as projections of climate change. The data are available for an area of about ½ degree ½ degree, or roughly 50km x 50km near the equator. When you click on the map, the tool will pull data for the grid cell surrounding the point where you clicked and display it as a line graph. The data can be exported to a spreadsheet application.

IRI Data Access - Allows users to view data provided by The International Research Institute for Climate and Society (IRI), for the African region. In SERVIR Viz, you can view the IRI maps for a given date range, and click on points in Africa to generate graphs for the area. Products include: Malaria Early Warning System, and Desert Locust Area maps.

Historical Earthquake Query - Allows the user to search USGS Earthquake data with many variables (i.e. geographic area, time, magnitude, etc.) and displays results on the SERVIR-Viz terrain.

Virtual Earth - Connects to and uses data from Microsoft Local Live databases. This includes street maps, USGS imagery, and hybrid maps. Provides adjustable data visibility levels and an address finder.

Demis Worldmap - Adds a world map on the SERVIR-Viz terrain that includes hydrography, cities, airports, roads, and relief shading.

Topo Sheets - Adds topographic maps to the SERVIR-Viz terrain for Mesoamerican countries.

Vector Layers - Activates the Vector Layers under SERVIR Framework in the Layer Manager. The layers here include Main Roads, Rivers, Lakes, Watersheds, etc.

Fire Alerts - Activates the Fire Alerts layer under SERVIR Framework in the Layer Manager. The layer includes data from the past 24 hours or the last 7 days.

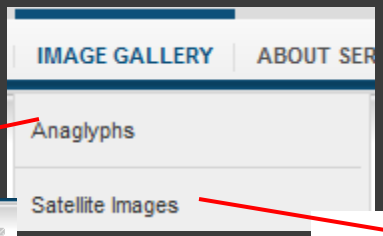
Floods - Activates the Floods layer under SERVIR Framework in the Layer Manager. The layer includes data from the last 14 days, labels for the flood areas, and historical data from years past.

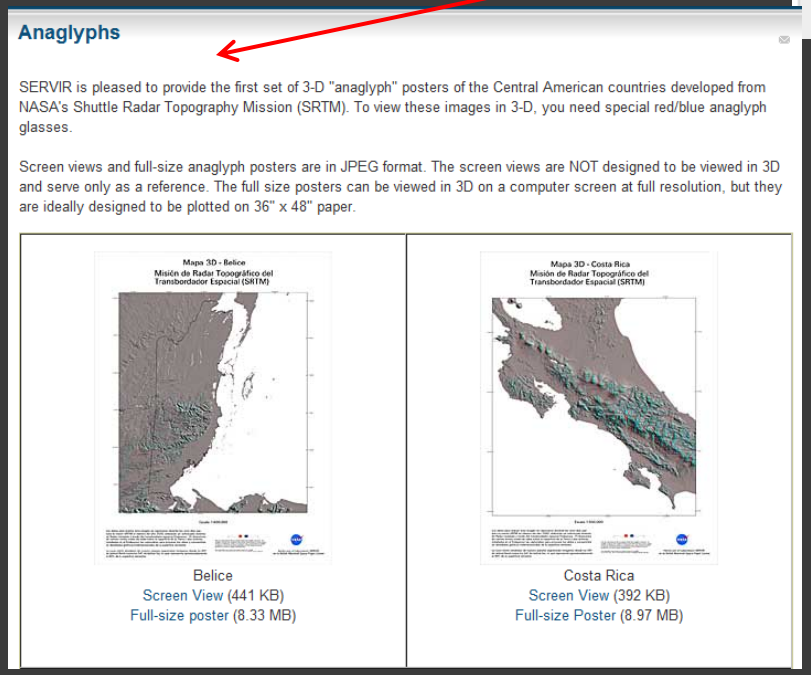
Volcanoes - Activates the Volcanoes layer in the Layer Manager. The layer includes data on volcanoes categorized by the country where they are located. Tooltips about each location are visible when label is hovered over with the cursor. Clicking the label activates a hyperlink to get more specific information.

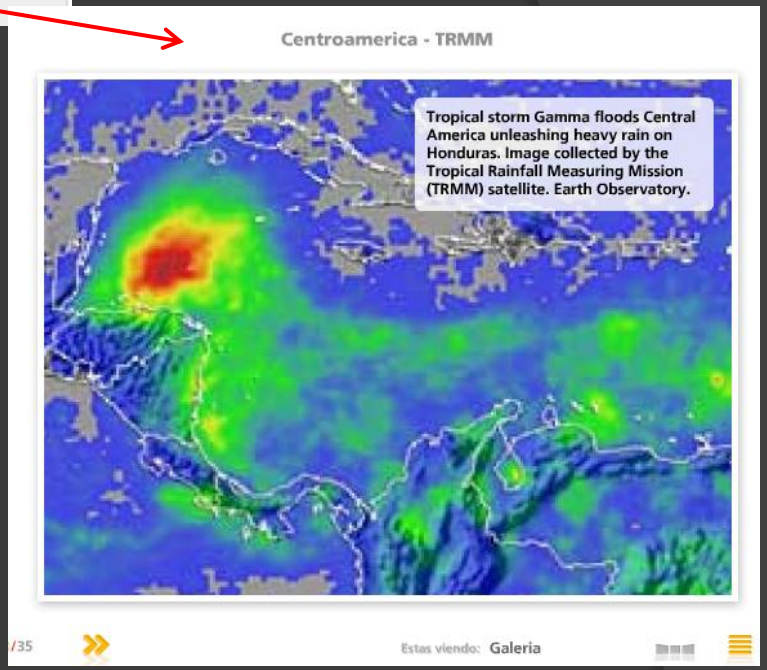
Placenames - Labels cities, counties, and countries based on the current zoom level.

Boundaries - Draws country boundaries and U.S. State boundaries.

SERVIR



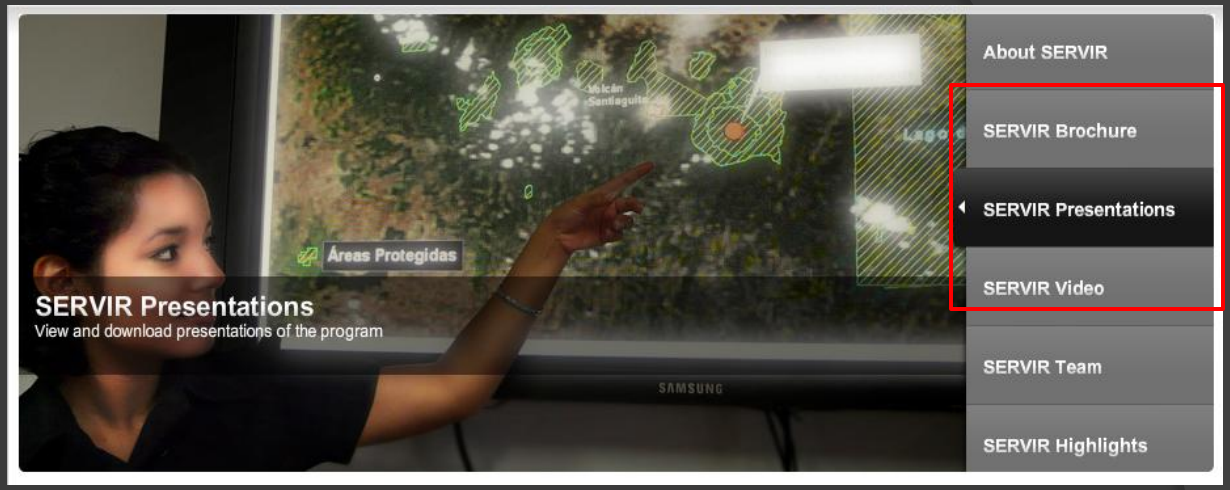


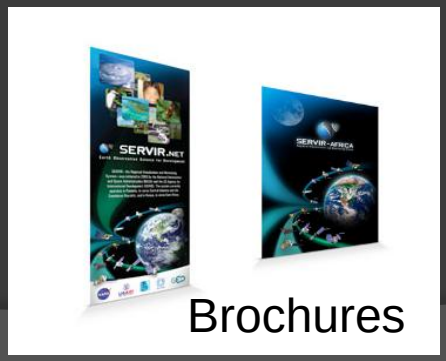


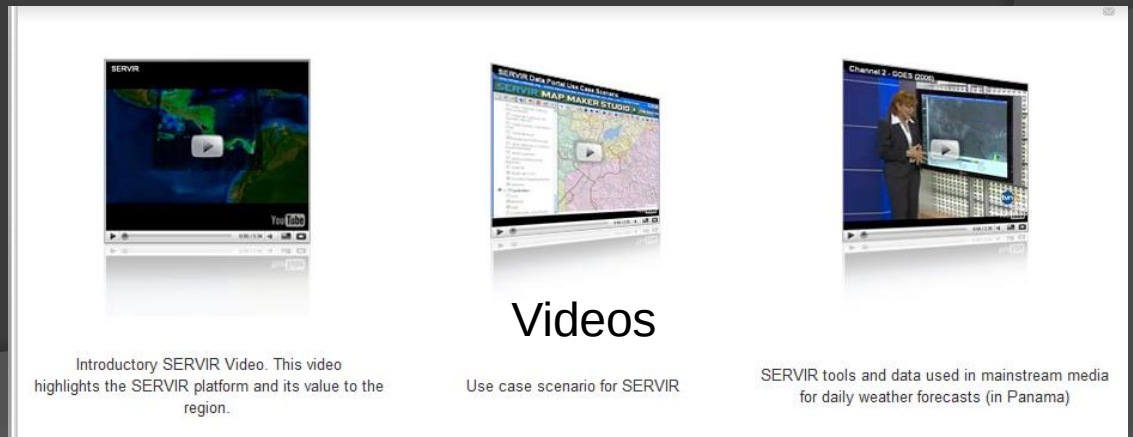
- The tab “IMAGE GALLERY” has links to anaglyphs and satellite images of environmental issues
- Users can view the anaglyphs and print them

SERVIR

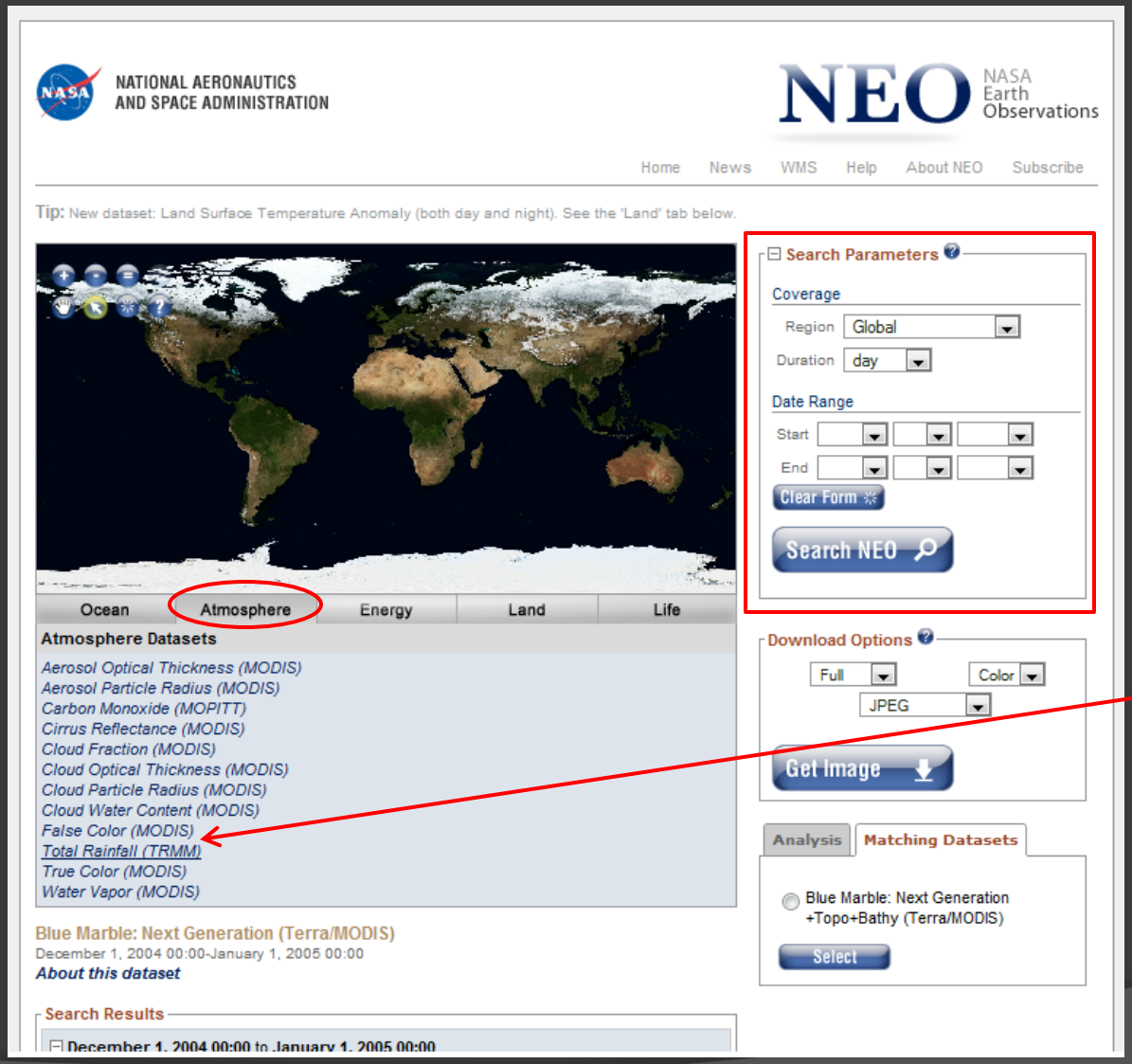
- For more information about SERVIR, check out the brochure, presentations, and video





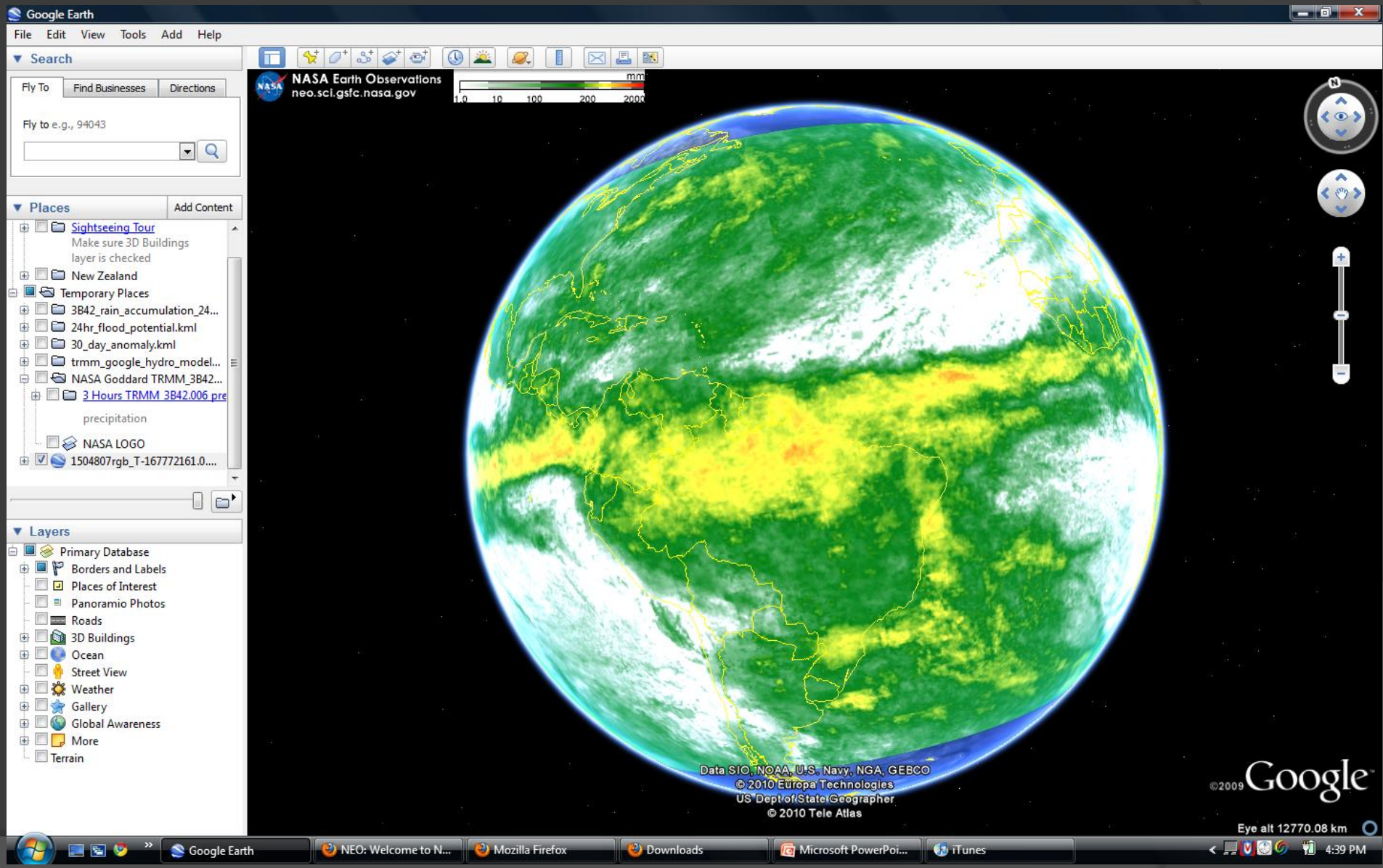


NASA Earth Observations (NEO)



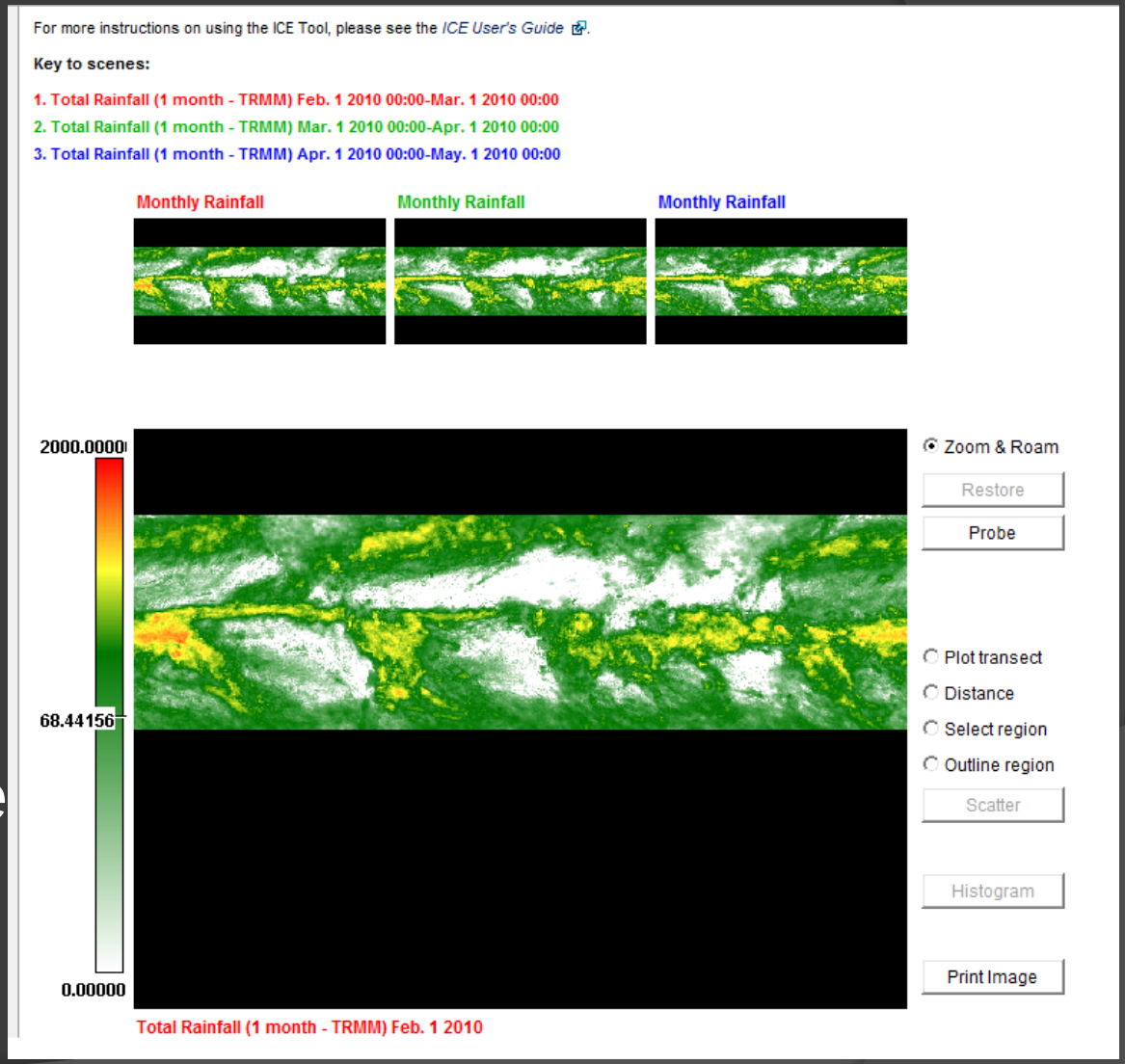
- http://neo.sci.gsfc.nasa.gov/Search.html
- Provides global maps using a variety of datasets, including TRMM
- Expand “Search Parameters” to chose coverage, date range, and lat/lon range to search for data
- Access TRMM by clicking the Atmosphere tab, followed by Total Rainfall (TRMM)
- Can download the data in multiple file types, including Google Earth
- Can also perform analysis on 1-3 images and get matching datasets

NEO Image in Google Earth



NEO Analysis

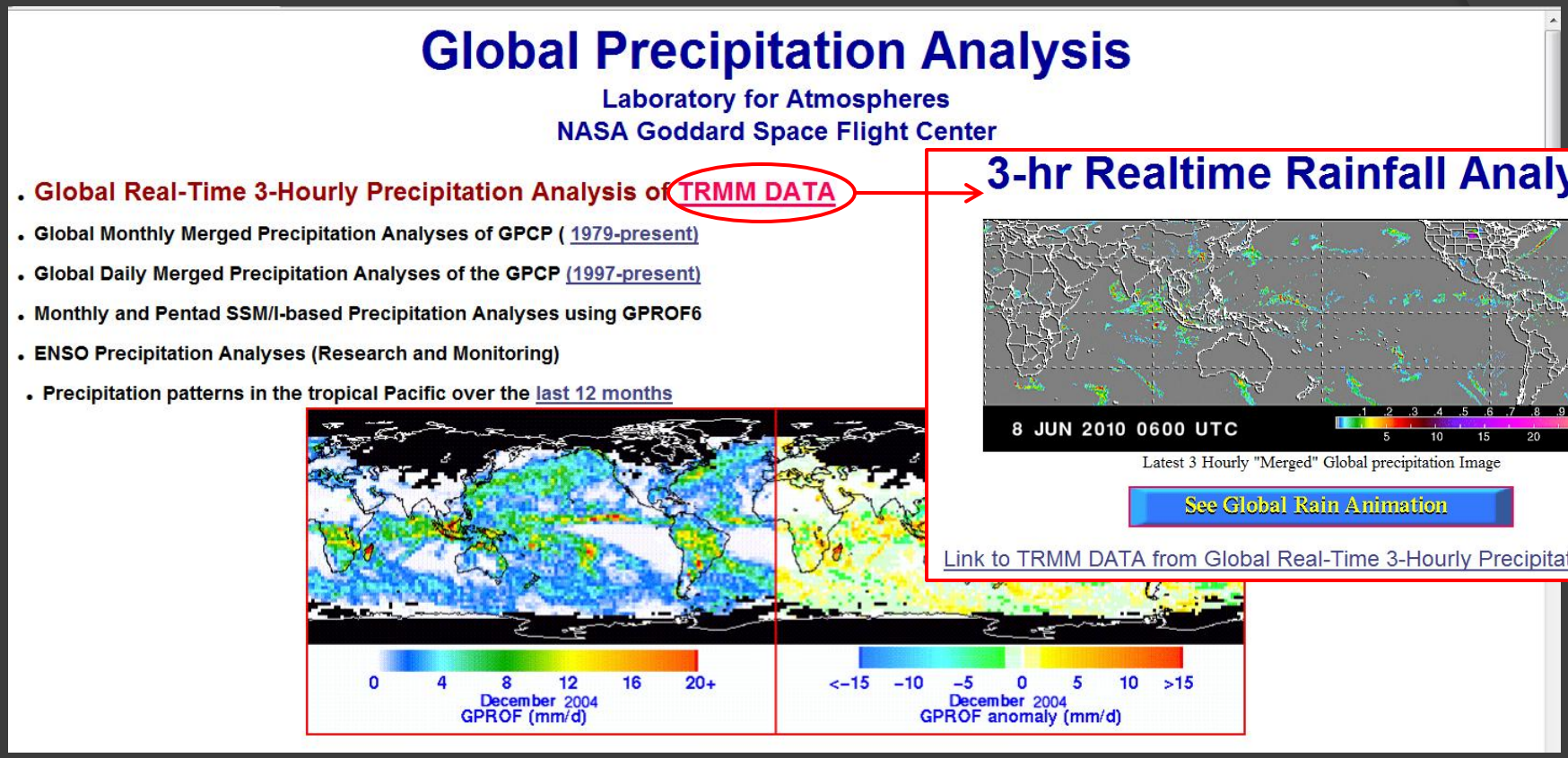
- By selecting 1-3 images from the Search results boxes, the user can analyze the TRMM data alone or with other maps
- It uses the ICE tool, and creates transects, scatter plots, and histograms, allowing the user to select the area for analysis, zoom, probe, and print image



Global Precipitation Analysis (GPCP)

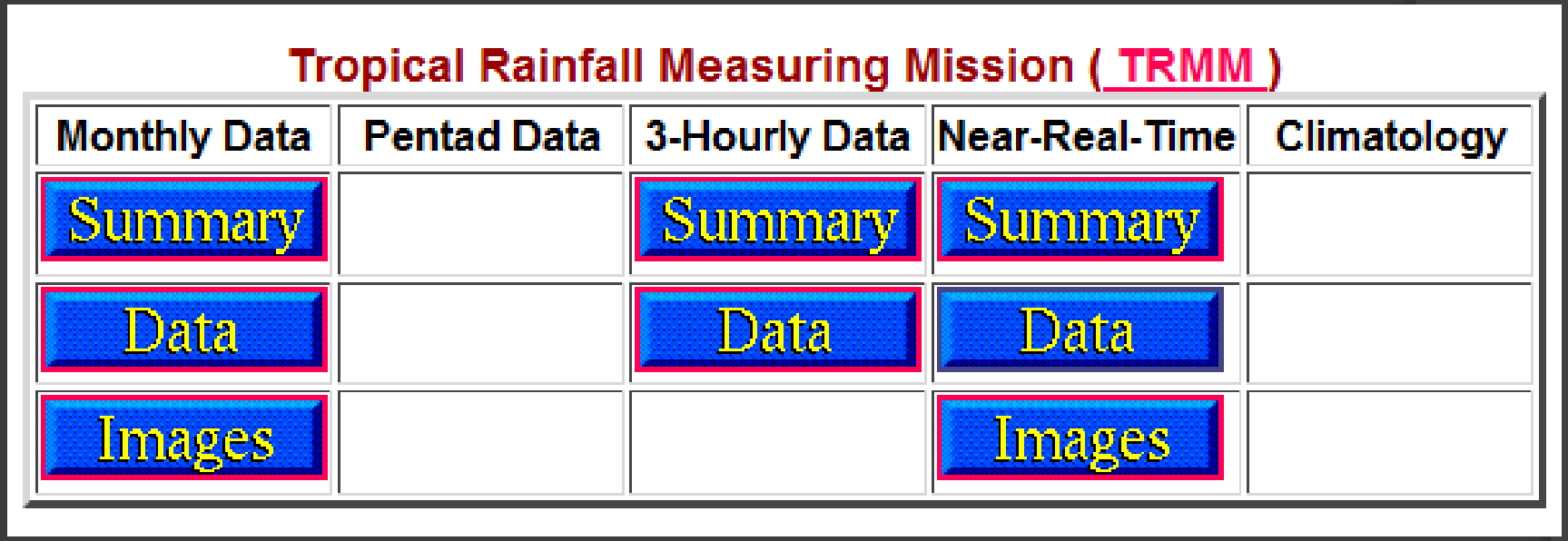
- The Global Precipitation Climatology Project (GPCP) is a project whose goal is to develop a better understanding of global precipitation
- GPCP uses data from rain gage stations and satellites (including TRMM) to estimate global monthly rainfall from 1979 to present
  - Over 6,000 rain gage stations
  - Geostationary and low-orbit infrared, passive microwave, and sounding observations from satellites
- For a complete list and explanation of the data products, visit http://lwf.ncdc.noaa.gov/oa/wmo/wdcamet-ncdc.html

Global Precipitation Analysis (GPCP)



- http://precip.gsfc.nasa.gov/
- Clicking “TRMM DATA” brings the user to a real-time global map of precipitation
- By clicking the link beneath the map, an animation of about a week of recent global precipitation is generated
- The user can also access the TRMM data

Global Precipitation Analysis (GPCP)

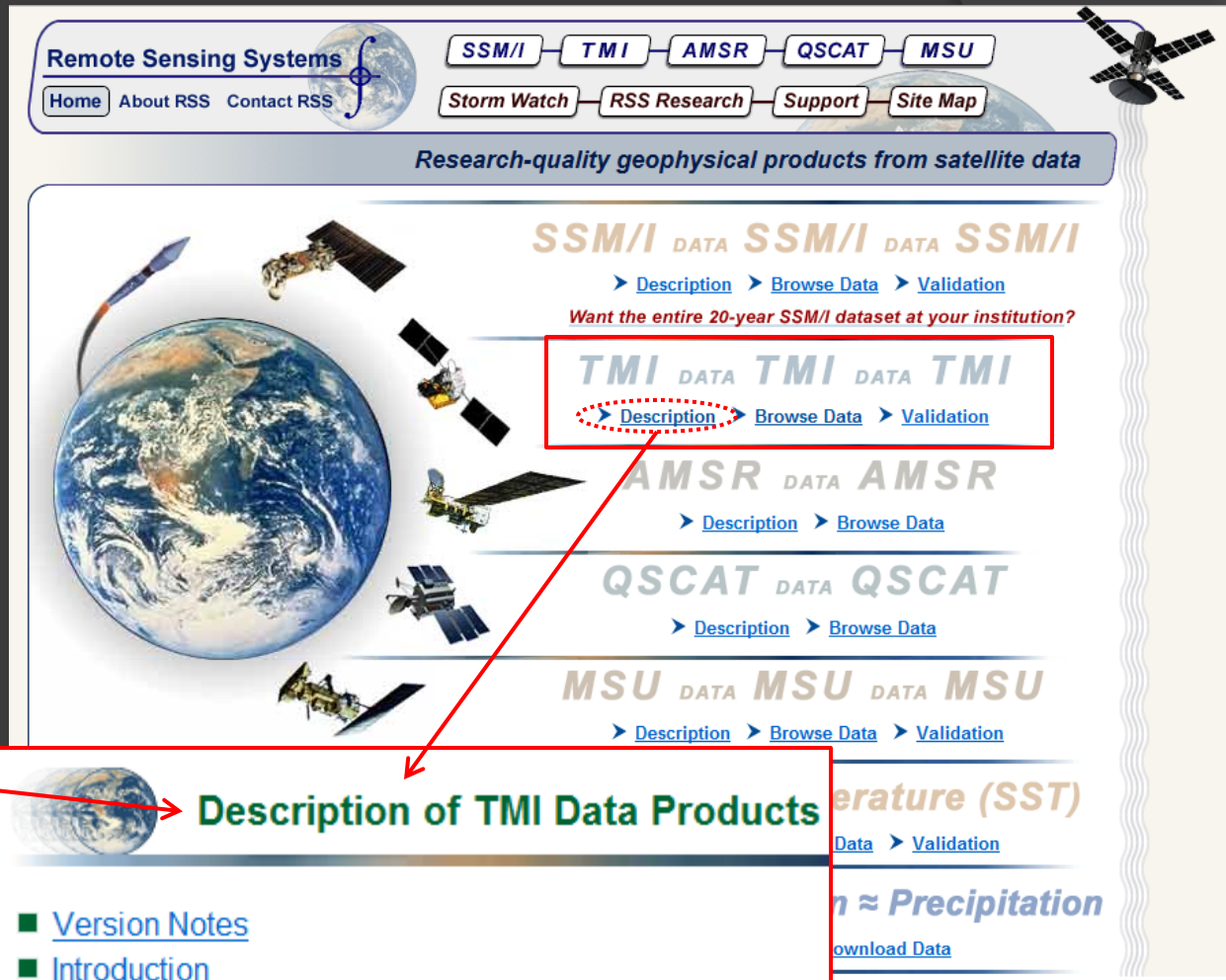


Scrolling down to the bottom of the homepage, there is a variety of TRMM links including Summary, Data, and Images of monthly, 3-hourly, and near-real-time data

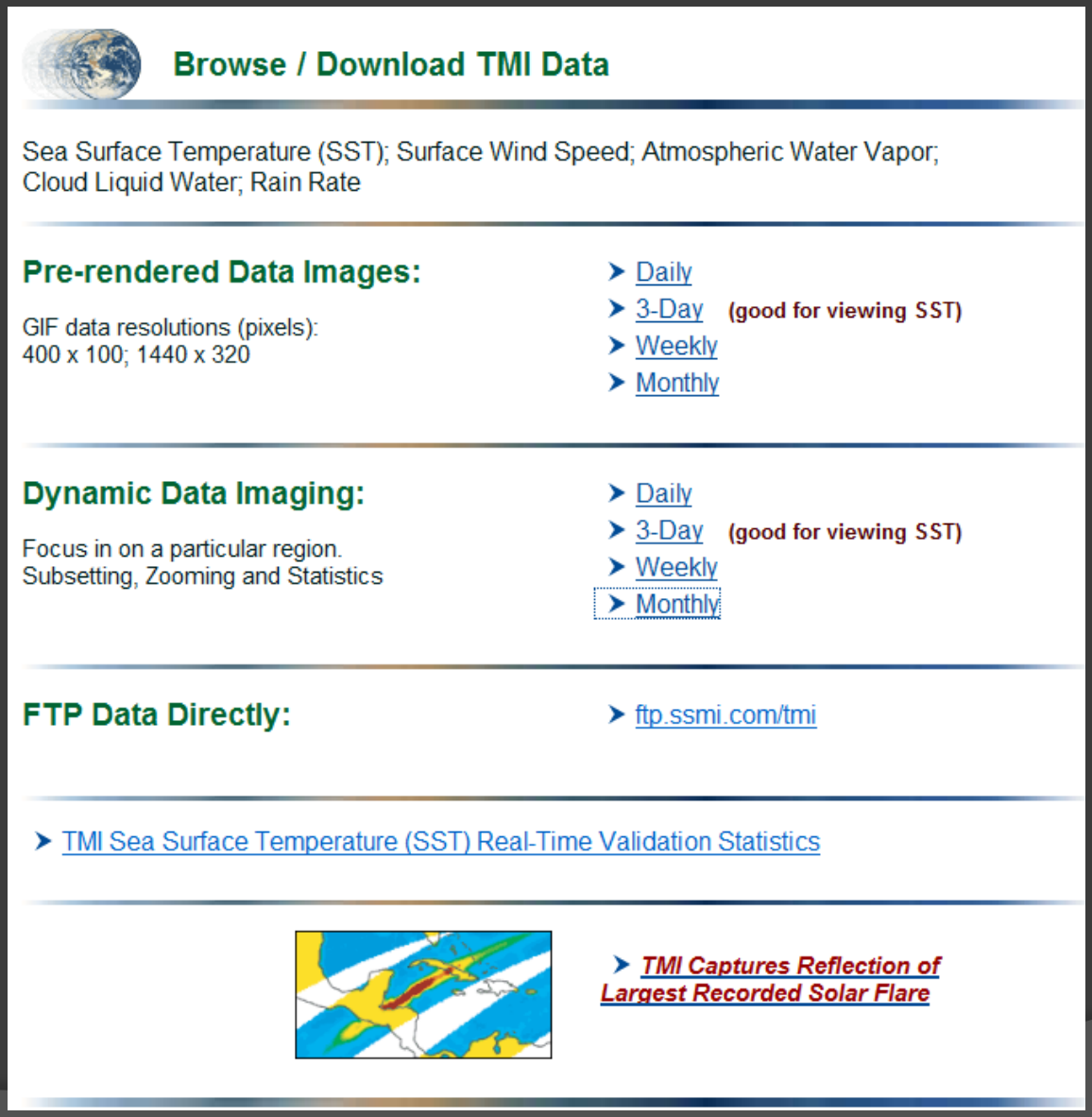
- Summary is a written description of the data and how it is compiled
- Data is the actual data files
- Images shows global images of the data
  - Monthly data images displays monthly averages of the TRMM precipitation data from 1998 to 2009
  - Near-Real-Time images displays the same page as the TRMM DATA link at the top of the page

Remote Sensing Systems

- http://remss.com
- This tool looks at the data collected from the TRMM's TMI instrument
  - Includes SST, surface wind speed, atmospheric water vapor, cloud liquid water, and rain rate
- The description link provides an in depth explanation of the data and products featured on the page



Remote Sensing Systems

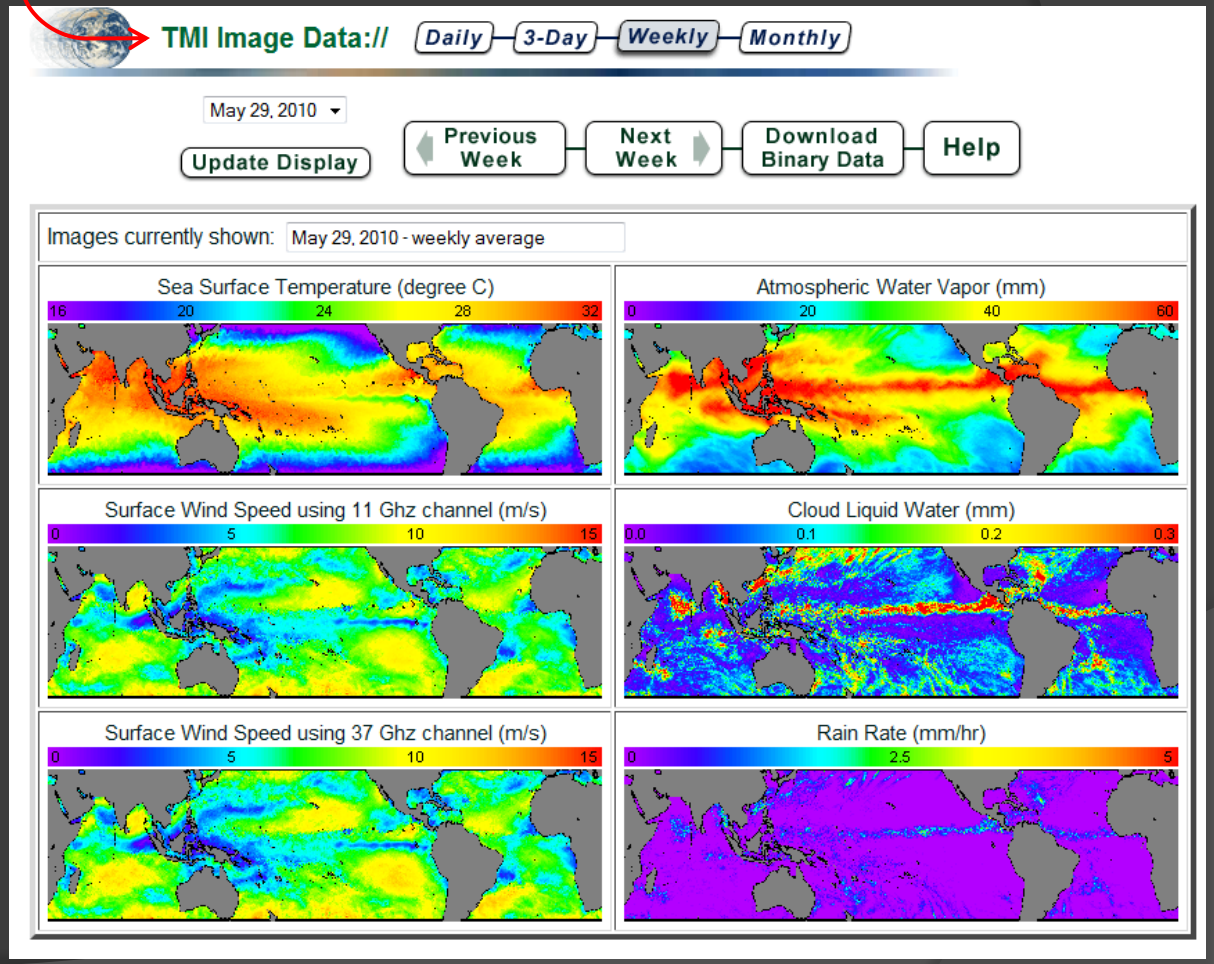


- Browse data link opens a page where the user can view and download pre-rendered and dynamic data images
- Each link looks at the SST, surface wind speed, atmospheric water vapor, cloud liquid water, and rain rate over the oceans only, for the time period specified

RSS – Pre-rendered Images

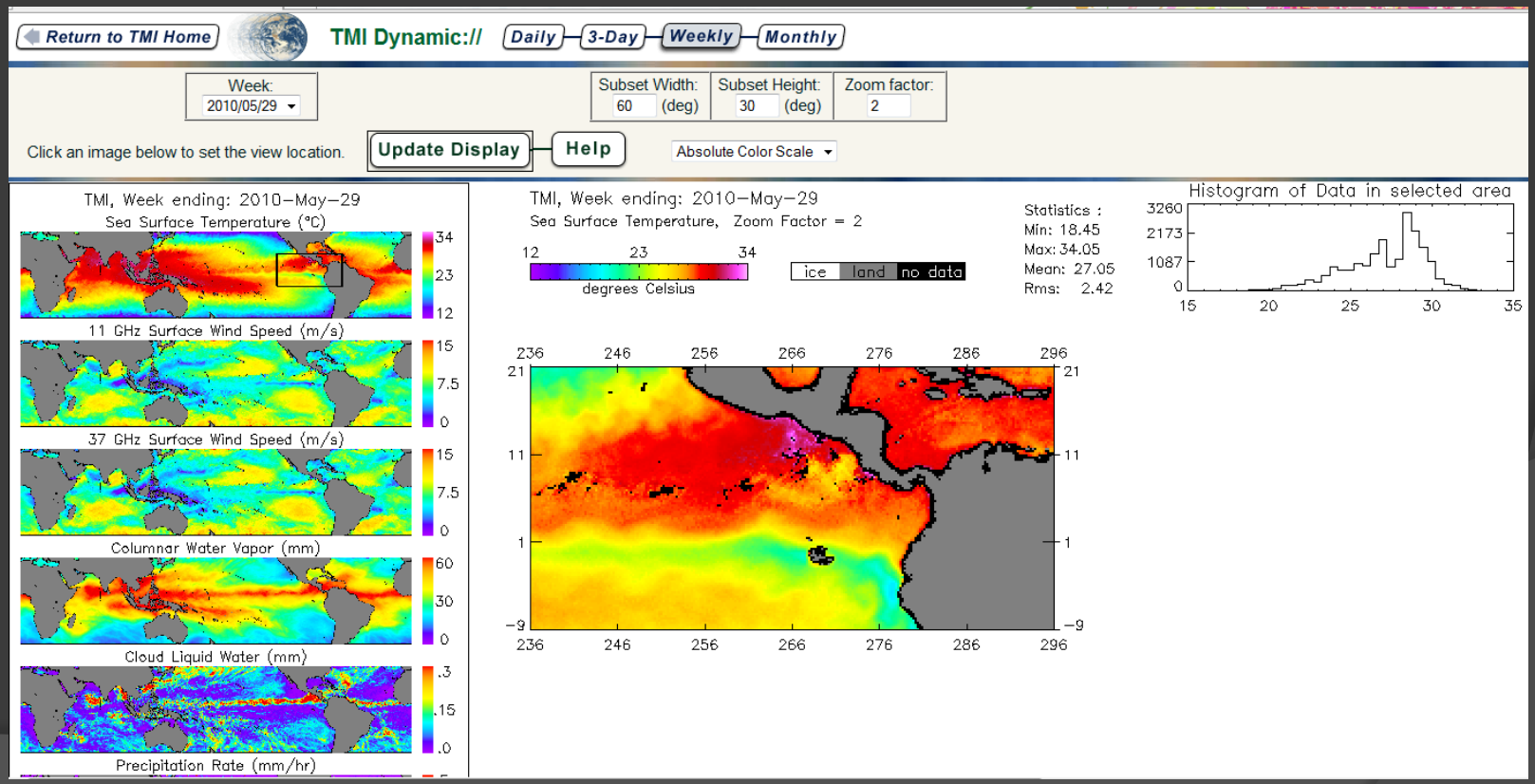
- Pre-rendered images allows the user to select the date of data collection (pass and time can be selected for daily data only)
- Clicking on a map opens a larger version of it
  - The user can download any of this data by clicking the link “Download Binary Data”

This link bar allows for easy navigation between Daily, 3-Day, Weekly, and Monthly data



RSS – Dynamic Data Imaging

- Dynamic data imaging allows the user to select the date and region to analyze
- It also provides the user with statistics and a histogram of the data selected



RSS - Validation

http://remss.com/tmi/tmi_validation.html

TMI Data Validation

RSS performs extensive algorithm validation to determine the quality of our data. We maintain a dataset of over 8 million buoy observations to use in validating the TMI products we produce.

- Version-3a TMI Sea Surface Temperature (SST) Realtime Validation Statistics
- Validation of Version-2 TMI Sea Surface Temperature (SST)
- Validation of Version-2 TMI Wind Speeds

TOP

Validation of Version-2 TMI Sea Surface Temperatures

Validation of satellite-derived SSTs is necessary to check the retrieval algorithm developed for the TMI 10.7 GHz channel. The validation process includes comparison of TMI SSTs to *in-situ* measurements made by moored buoys located in both the tropical Pacific and tropical Atlantic oceans.

The tropical Pacific moored ocean buoys consist of mostly TAO array buoys. Hourly data from the approximately 60 buoys that make up the array are obtained from the Pacific Marine Environmental Lab (PMEL). The remaining Pacific Ocean buoys are operated by the National Data Buoy Center (NDBC). The NDBC provides data from moored buoys along the US coasts and have approximately 20 buoys greater than 35 km from land on the Pacific (8) and Atlantic (11) coasts. We also compare our TMI SSTs to daily SST observations from the PIRATA buoys moored in the tropical Atlantic Ocean.

Data comparisons are made for the December 1997 to June 1999 time period. During this time we have over 9000 TMI to TAO/NDBC buoy collocations and approximately 1500 PIRATA daily collocations. TMI and buoy SST collocations were used only for rain-free atmospheric conditions. We found small differences between the TMI and buoy SSTs. The TMI minus TAO difference when averaged over all buoys is 0.1 degree Celsius and the mean TMI minus NDBC SST difference is 0.2 degree Celsius. The standard deviation for both was approximately 0.5 degree Celsius. Slightly better results were found when we averaged the hourly TAO/NDBC data to daily values and compared them with TMI 3-day mean SSTs. The PIRATA buoy data, though fewer in number, on average showed no difference from the TMI SSTs, and had a standard deviation of 0.4 degree Celsius.

A time series of two Central Pacific buoys located within 0.1 degree longitude of each other and TMI SST

http://remss.com/tmi/tmi_sst_validation_statistics.html

TMI SST Near Real-Time Validation Statistics

- TMI SSTs Compared with In Situ Observations
- TMI SSTs Compared with Reynolds SSTs

TOP

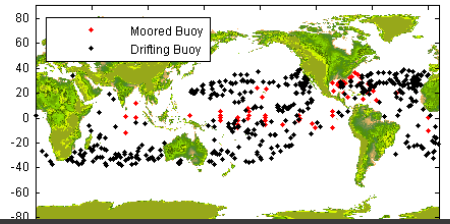
TMI SSTs Compared with In Situ Observations

Near real-time (NRT) in situ observations are downloaded from the Global Ocean Data Assimilation Experiment (GODAE) Monterey server, which is sponsored by the Office of Naval Research (ONR) and hosted by the Fleet Numerical Meteorology and Oceanography Center (FNMOC). These observations are obtained by FNMOC from the GTS and processed for the GODAE server. Observations from ship engine room intake, fixed buoy, drifting buoy, ship hull sensors, and CMAN stations are included in the dataset. See the USGODAE Project for the complete SURFOBS dataset and a detailed description.

To perform this comparison with TMI, in situ observations are collocated with the closest TMI SST observations (within 25 kilometers; to the nearest TMI observation time). The complete collocated dataset is available below in text format, but for a quick understanding of the NRT error statistics, the previous 50-day bias and standard deviation are plotted below.

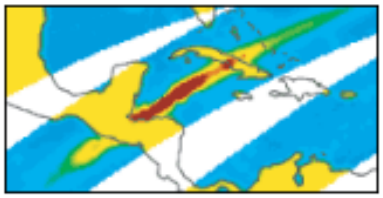
TOP

In Situ Data Collocations for the Most Recently Completed Day:



- From the homepage link, “Validation” and also the SST Validation link on the Browse Data page, the user can access text, statistics, and figures that validate the data compiled on the website

RSS – Did you know?

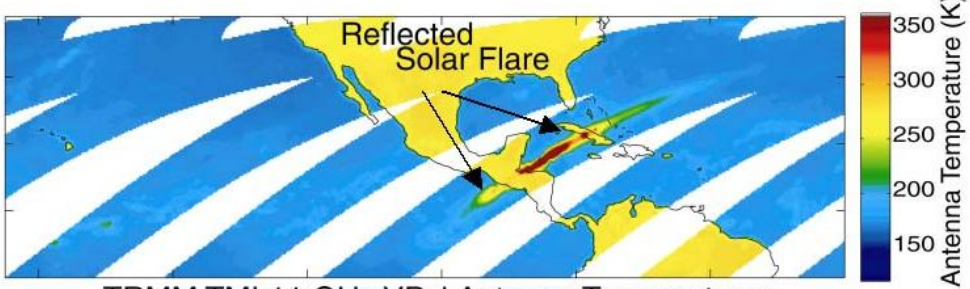


➤ ***TMI Captures Reflection of Largest Recorded Solar Flare***

- At the bottom of the Browse Data page, there is a link describing how the TMI instrument captured the reflection of the largest recorded solar flare on November 4, 2003

TMI Views Solar Flare

TMI Captures Ocean Reflection of Largest Recorded Solar Flare



TRMM TMI 11 GHz VPol Antenna Temperatures

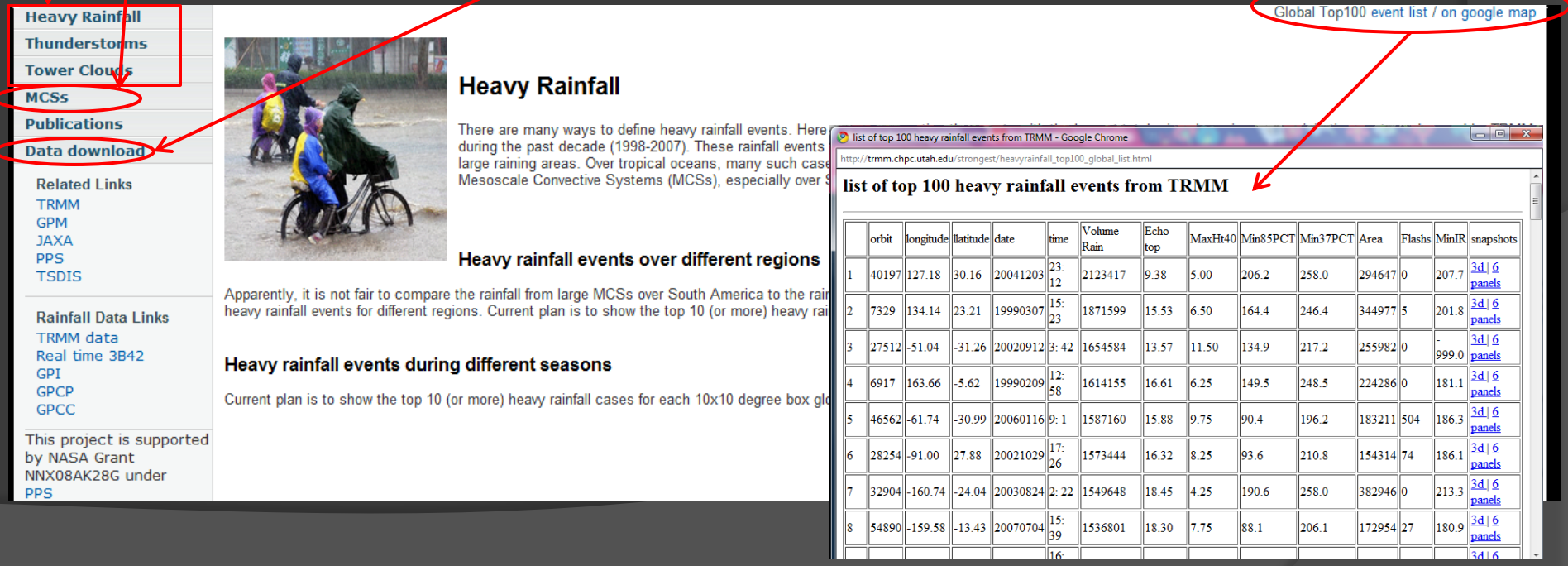
On November 4, 2003, at approximately 19:47 UTC, the largest solar flare event ever recorded erupted. The extremely intense radiation coming from the flare saturated x-ray detectors for 11 minutes. The same hyper-accelerated solar electrons that are responsible for the x-ray burst also emit intense microwave radiation. This burst of solar microwaves, traveling from the sun to the Earth in 8 minutes, reflected off the ocean surface and was seen by the TRMM microwave imager (TMI). The radiation was so intense that it saturated the 11-GHz TMI channels.

Remote Sensing Systems (RSS) detected this event during a routine data quality check that revealed anomalous geophysical retrievals. RSS processes TMI data into a suite of ocean products, including ocean temperature, wind speed, atmospheric water vapor, cloud, and rain rates, for use in weather forecasting, climate modeling, and scientific research. The erroneous ocean retrievals were traced back to exceptionally high microwave radiances coming from the solar flare.

Imagine looking at the ocean on a sunny day. When you look at a certain angle, you see the sun's reflection. This angle is the specular reflection angle. Occasionally the satellite's viewing angle matches the specular reflection angle. Serendipitously, TMI was looking at the specular reflection of the sun at the time of the solar flare event. The 11-GHz solar reflection as seen by TMI increased more than 100-fold during the 11-minute flare.

TRMM – University of Utah

- The University of Utah's TRMM webpage displays an in depth list of the top 100 heavy rainfall events, thunderstorms, and tower clouds recorded by TRMM (includes snapshots)
- MCSs can also be searched for with a variety of parameters, resulting in a list of results with data, snapshots, and a link to google it
- Data can also be downloaded



	orbit	longitude	latitude	date	time	Volume Rain	Echo top	MaxHt40	Min85PCT	Min37PCT	Area	Flashs	MinIR	snapshots
1	40197	127.18	30.16	20041203	23:12	2123417	9.38	5.00	206.2	258.0	294647	0	207.7	3d | 6 panels
2	7329	134.14	23.21	19990307	15:23	1871599	15.53	6.50	164.4	246.4	344977	5	201.8	3d | 6 panels
3	27512	-51.04	-31.26	20020912	3: 42	1654584	13.57	11.50	134.9	217.2	255982	0	-999.0	3d | 6 panels
4	6917	163.66	-5.62	19990209	12:58	1614155	16.61	6.25	149.5	248.5	224286	0	181.1	3d | 6 panels
5	46562	-61.74	-30.99	20060116	9: 1	1587160	15.88	9.75	90.4	196.2	183211	504	186.3	3d | 6 panels
6	28254	-91.00	27.88	20021029	17:26	1573444	16.32	8.25	93.6	210.8	154314	74	186.1	3d | 6 panels
7	32904	-160.74	-24.04	20030824	2: 22	1549648	18.45	4.25	190.6	258.0	382946	0	213.3	3d | 6 panels
8	54890	-159.58	-13.43	20070704	15:39	1536801	18.30	7.75	88.1	206.1	172954	27	180.9	3d | 6 panels

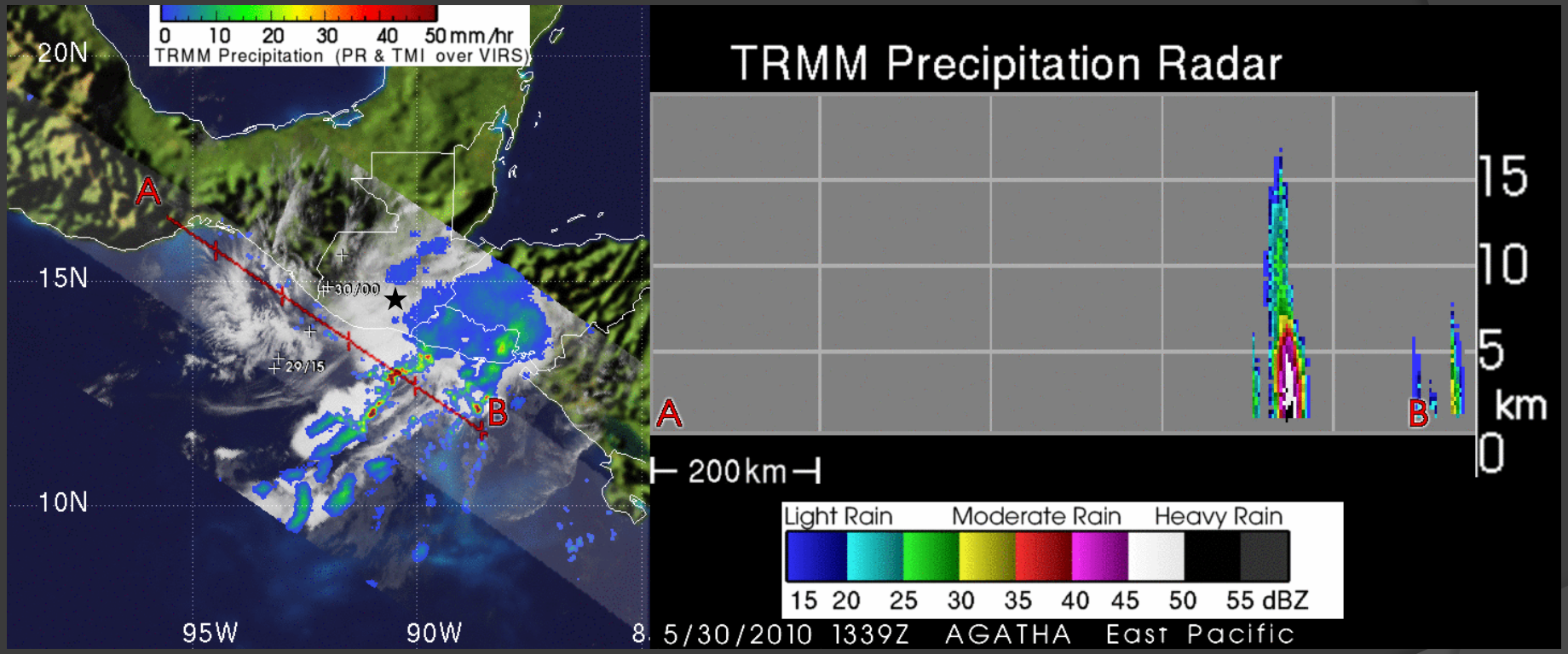
Investigating the 2010 Pacific Hurricane Season: Tropical Storm Agatha

A Case Study

Background

- First tropical storm of the 2010 Pacific season
- Originated in the Eastern Pacific near Central America
- Began on May 29th, and ended on May 30th
- Made landfall on Mexico-Guatemala border
- Agatha was a slow-moving system, which allowed for an excess of 20 in (510 mm) of rain to fall over El Salvador, Nicaragua, and Guatemala
- Heavy rainfall caused landslides and flooding which killed 180 people
- We will examine the affects that Agatha had on Guatemala using a variety of tools looking at TRMM precipitation data

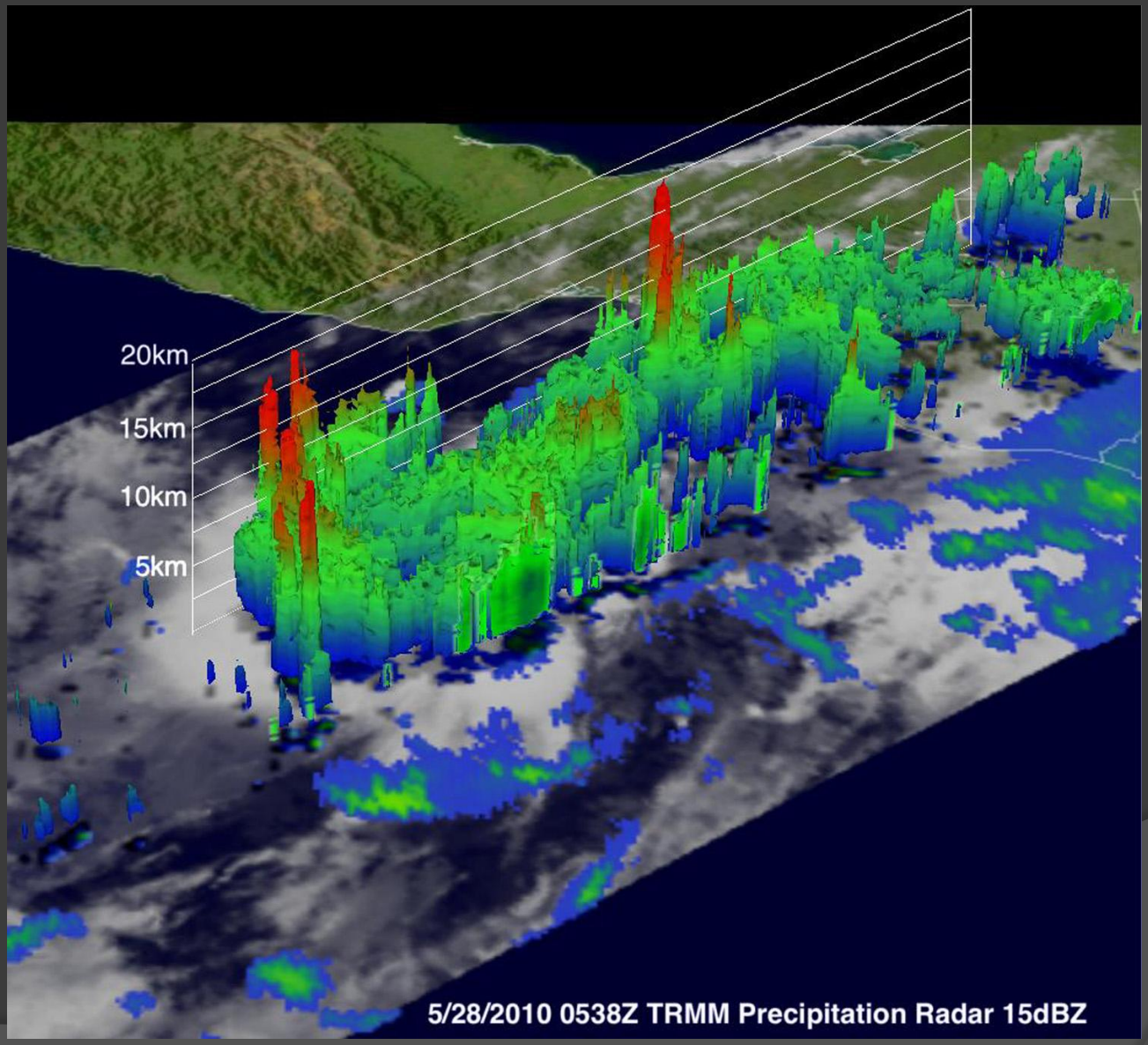
Examining Guatemala: TRMM - NASA



http://trmm.gsfc.nasa.gov/trmm_rain/Events/EPAC/EPAC.2010-5-30T1339Z_____AGATHA.gif

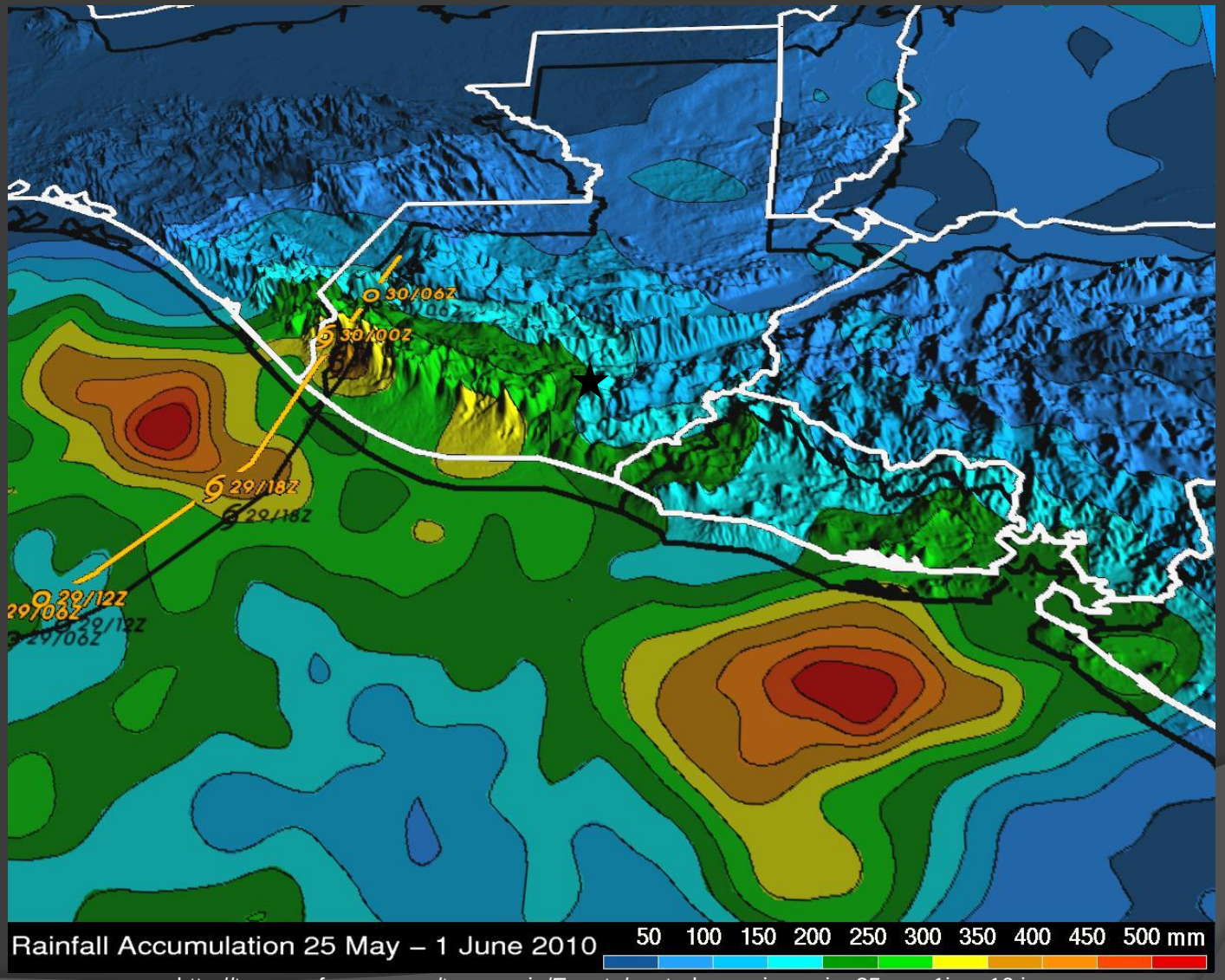
★ - Guatemala City

Examining Guatemala: TRMM - NASA



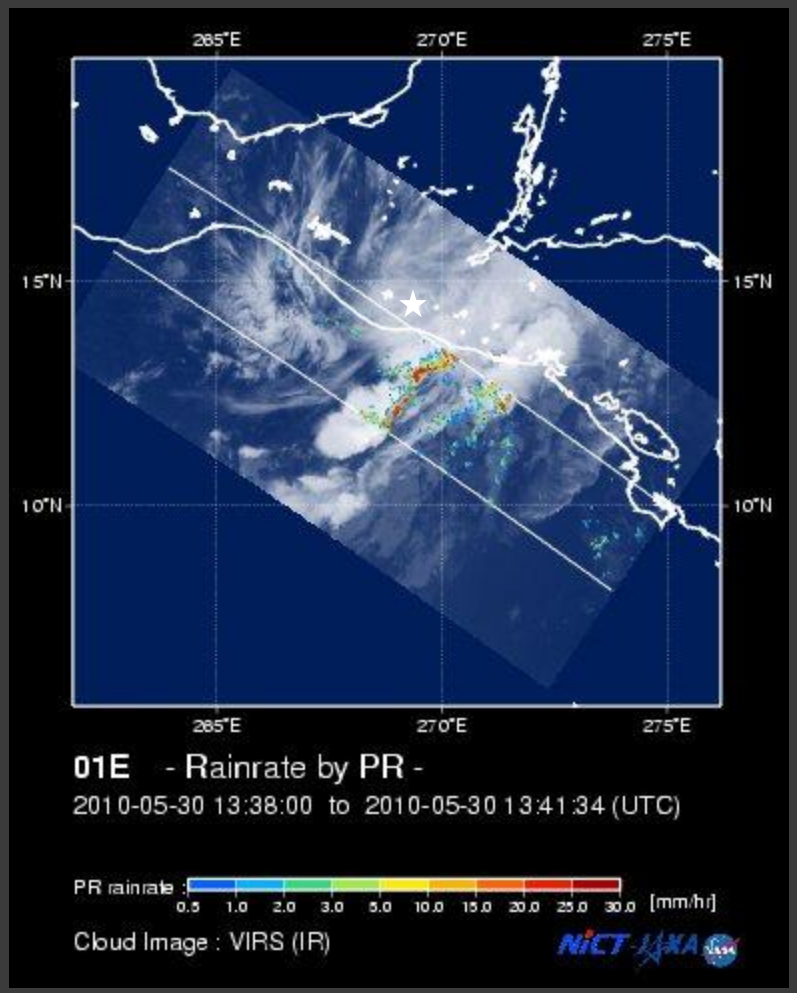
http://www.nasa.gov/images/content/460225main_AGATHA-TRMM-large.jpg

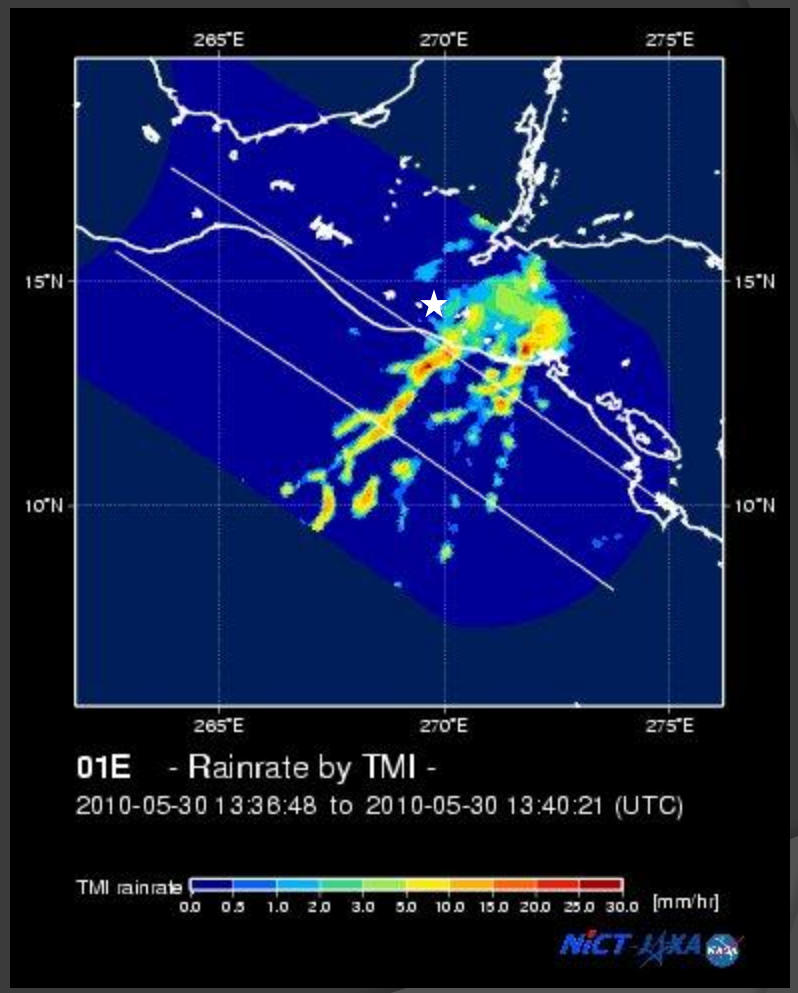
Examining Guatemala: TRMM - NASA



http://trmm.gsfc.nasa.gov/trmm_rain/Events/central_america_rain_25may-1june10.jpg

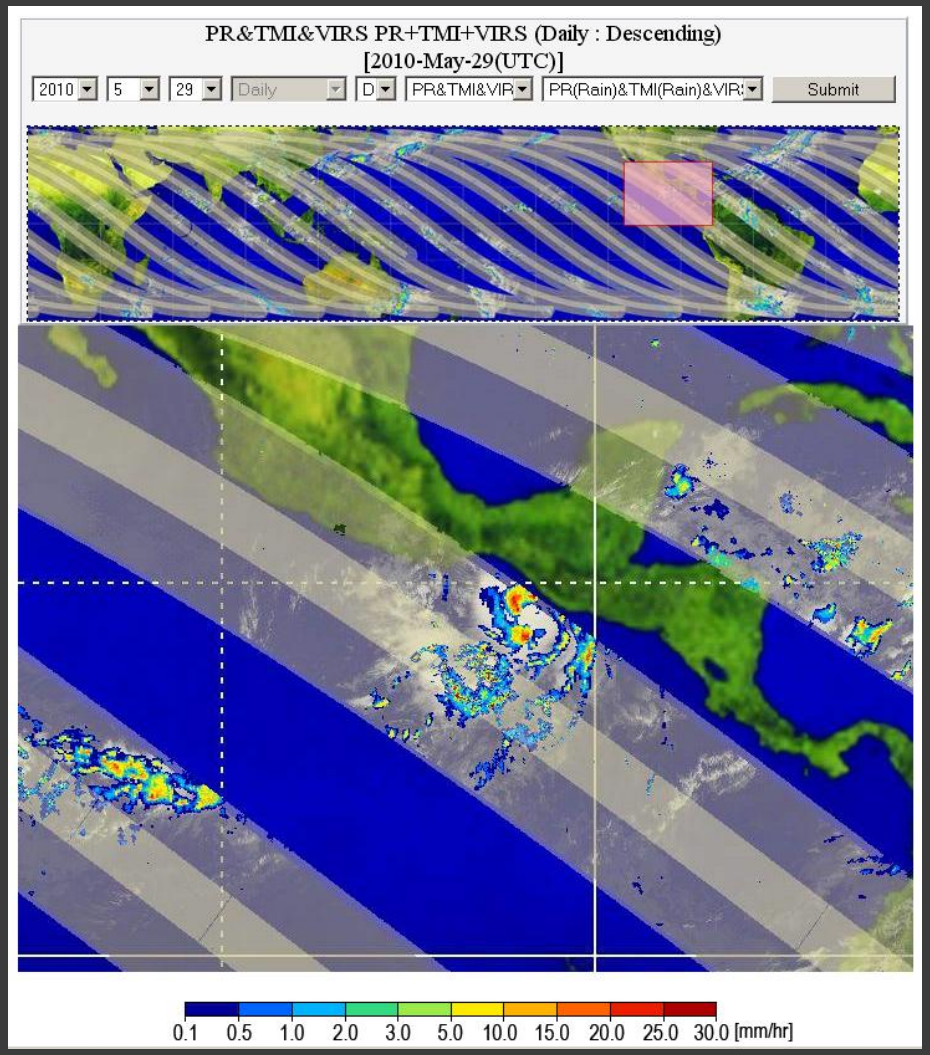
Examining Guatemala: TRMM - JAXA

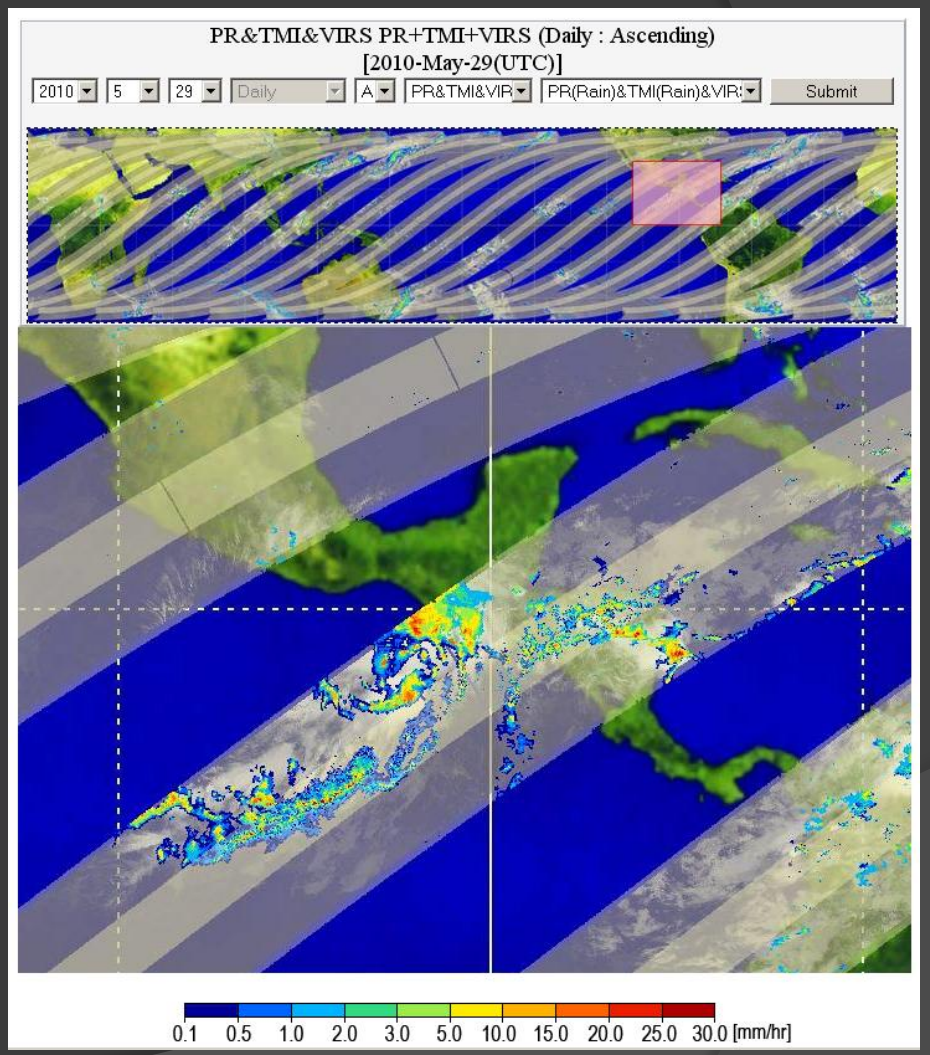




http://www.eorc.jaxa.jp/TRMM/NRTtyphoon/america_e.htm

Examining Guatemala: TRMM - JAXA

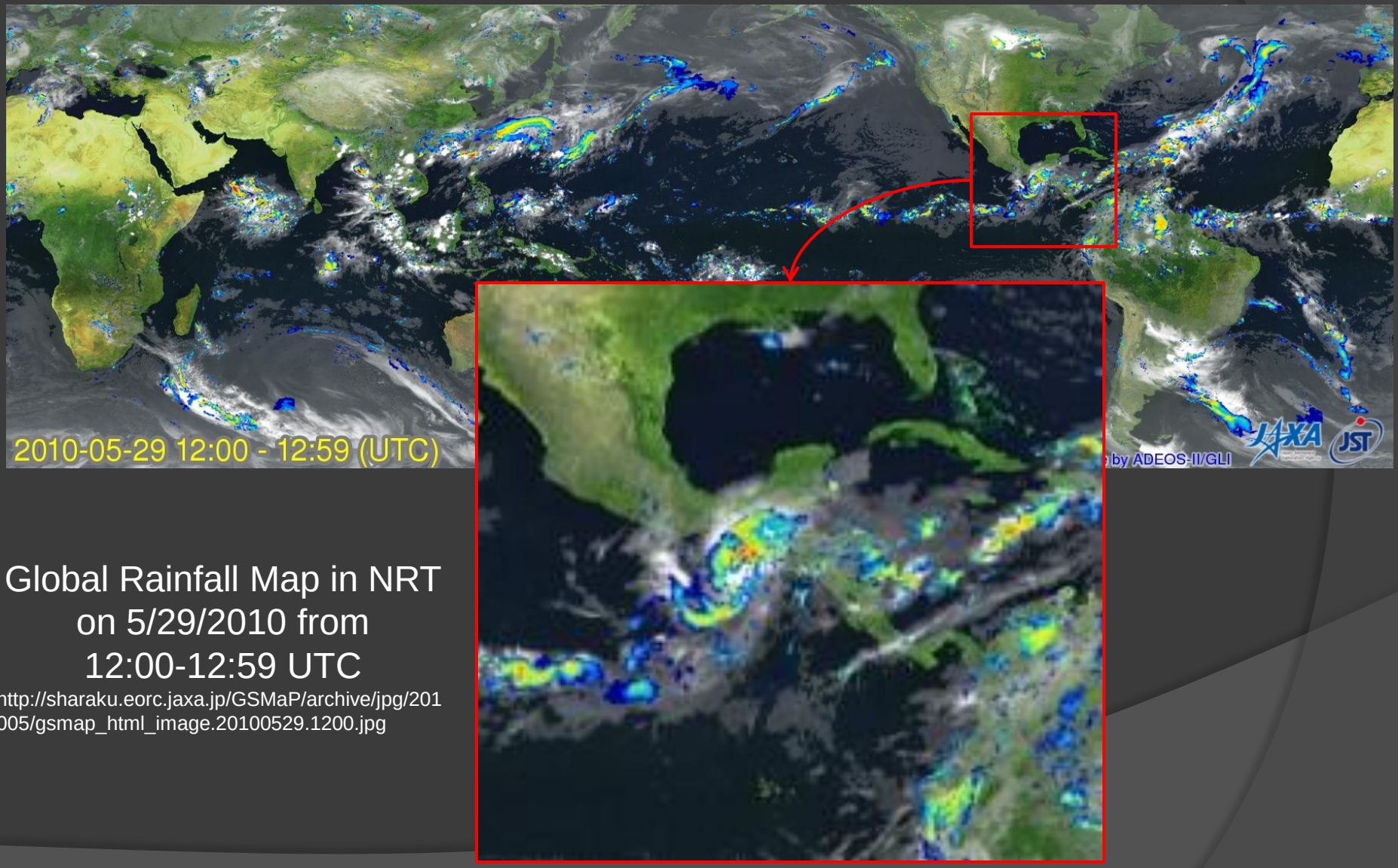




TRMM Real-Time images from 5/29/2010

http://sharaku.eorc.jaxa.jp/trmm/RT/index_e.html

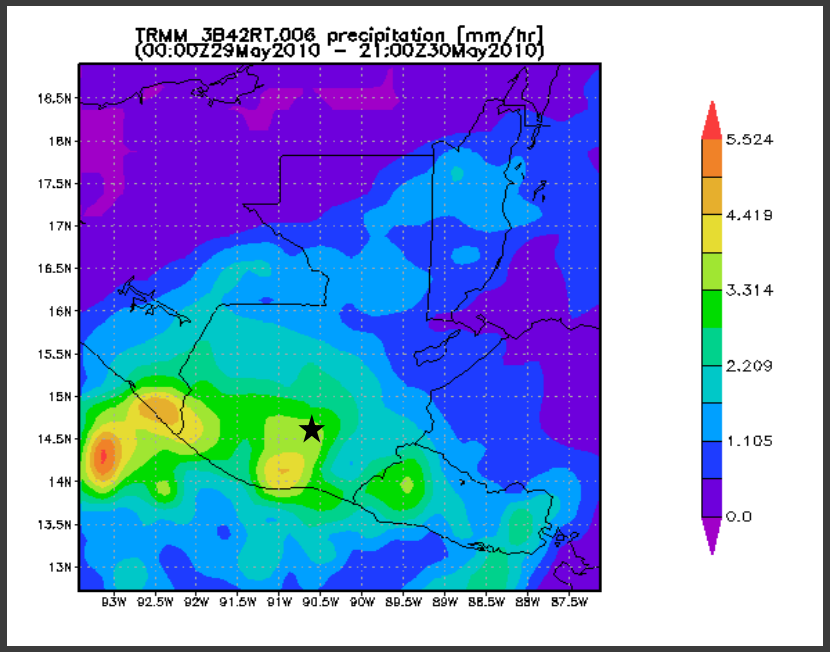
Examining Guatemala: TRMM - JAXA

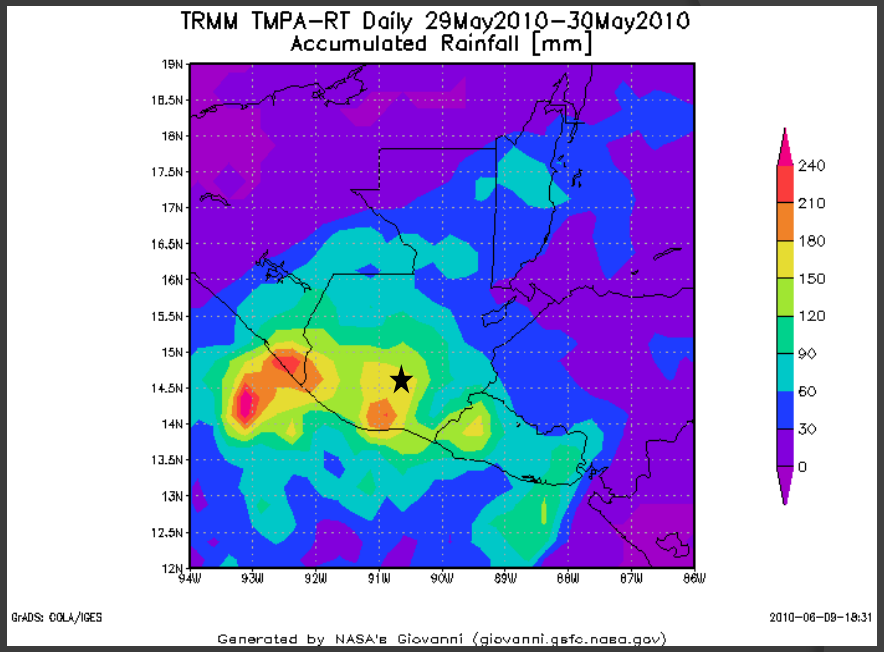


Global Rainfall Map in NRT on 5/29/2010 from 12:00-12:59 UTC

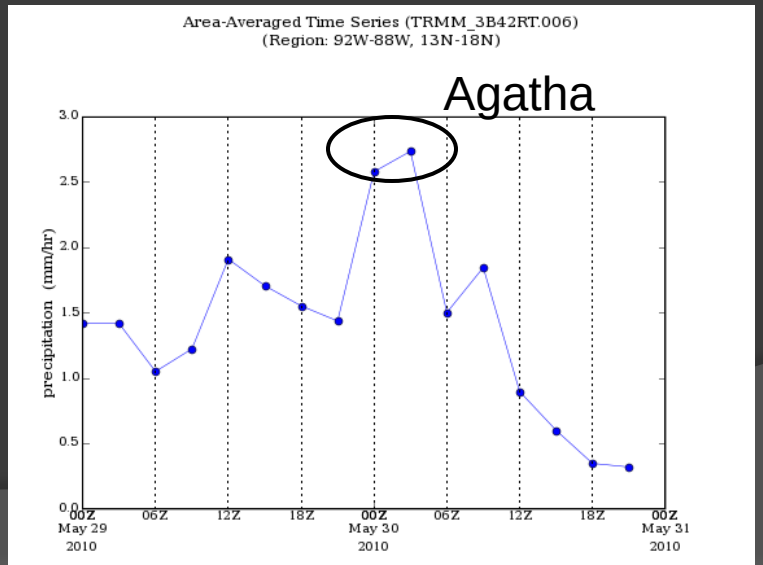
http://sharaku.eorc.jaxa.jp/GSMaP/archive/jpg/201005/gsmap_html_image.20100529.1200.jpg

Examining Guatemala: GIOVANNI

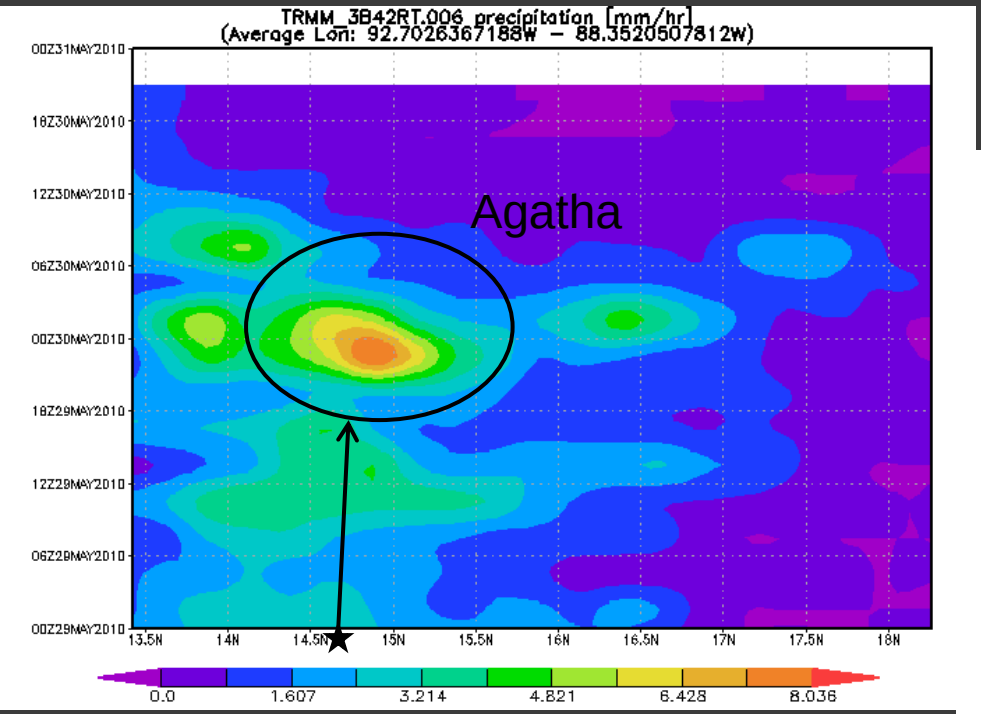


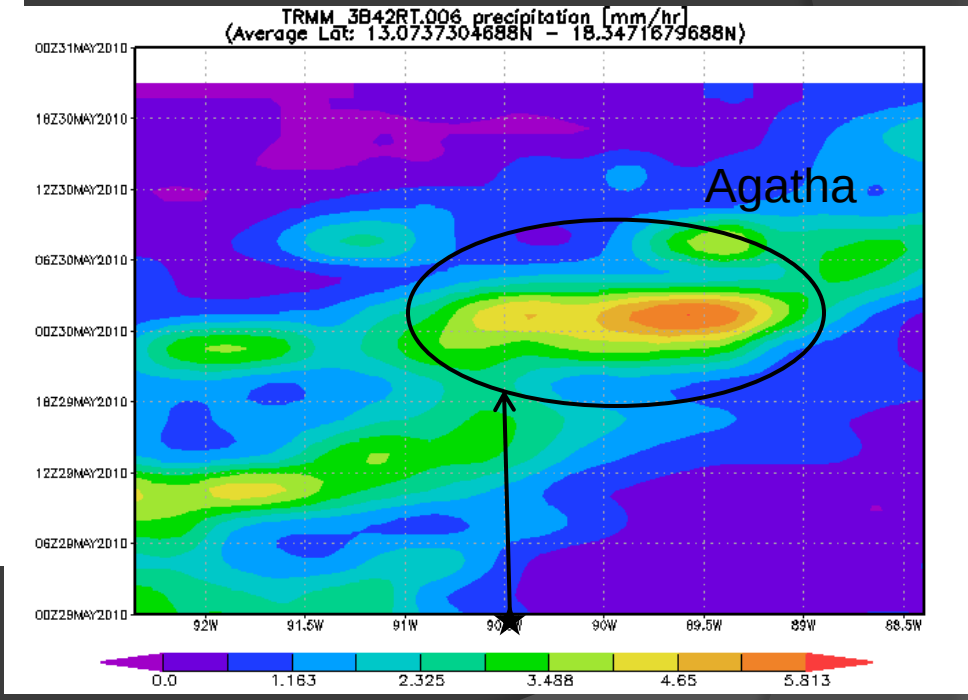


All images generated with GIOVANNI TOVAS http://disc2.nascom.nasa.gov/Giovanni/tovas/

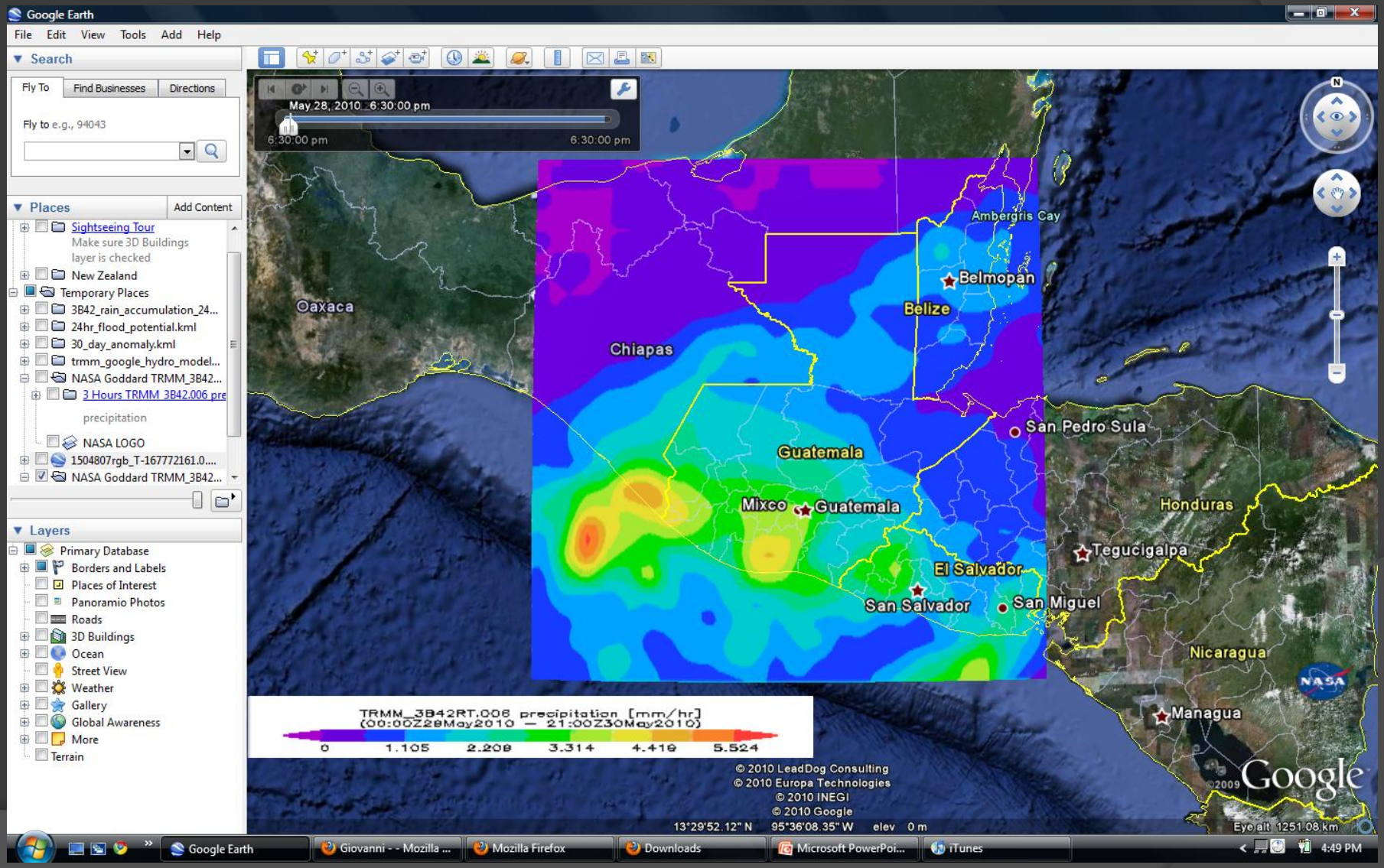


Examining Guatemala: GIOVANNI

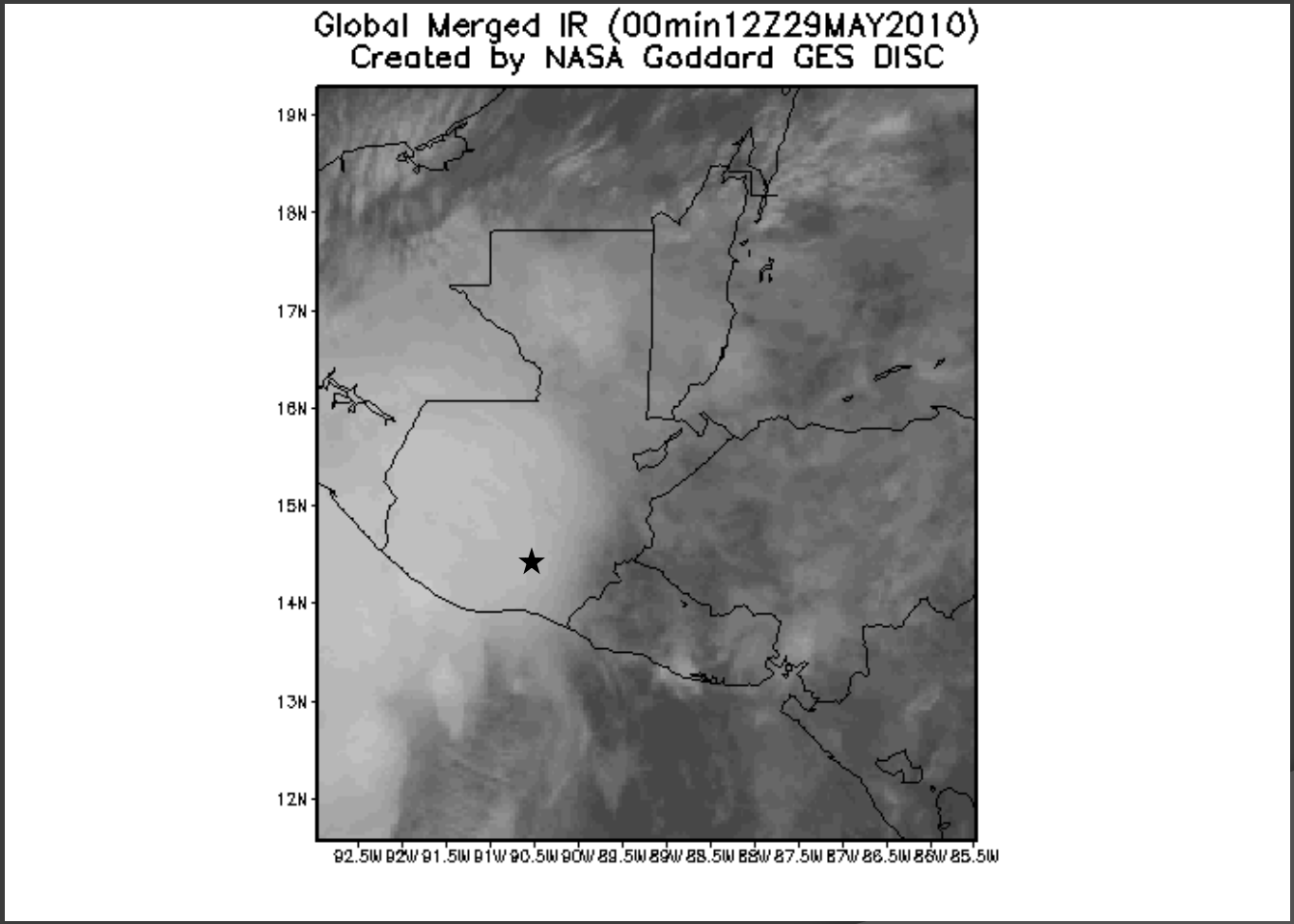




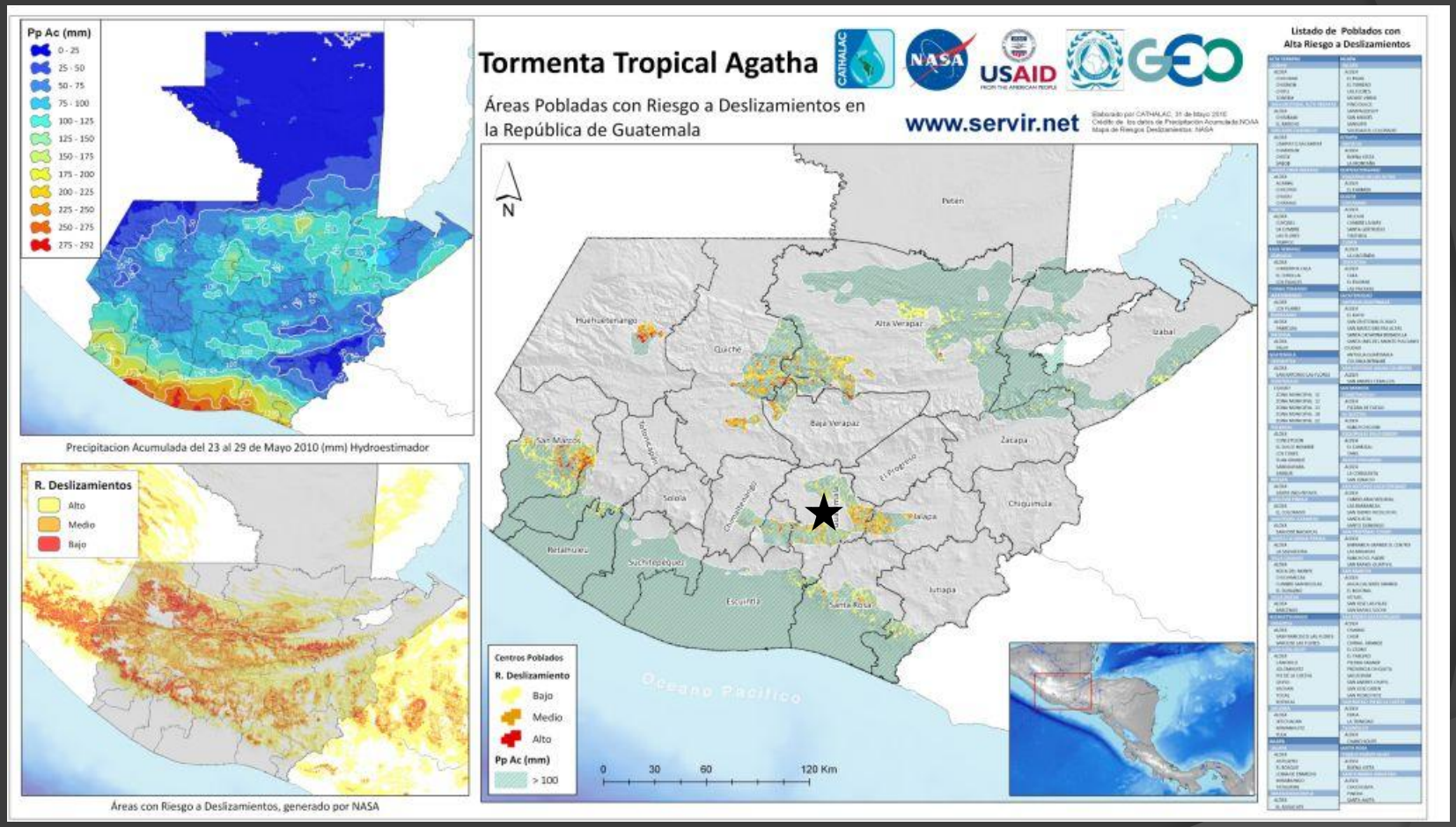
Examining Guatemala: GIOVANNI in Google Earth



Examining Guatemala: Hurricane Analysis Tool



Examining Guatemala: SERVIR



Areas at risk for landslides 5/29

http://www.servir.net/tormenta_tropical_agatha_mayo_2010

Examining Guatemala: SERVIR

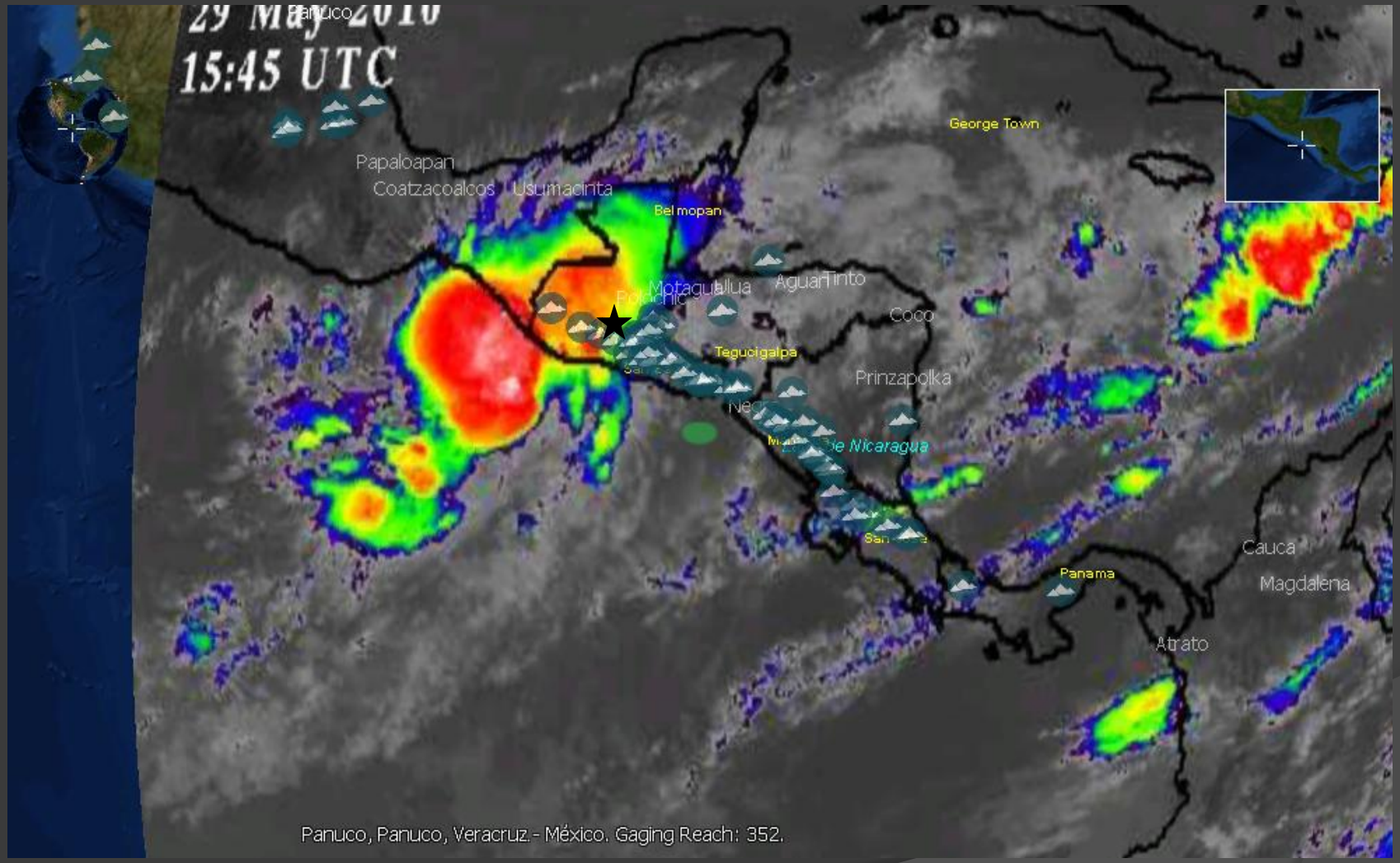


Image generated from SERVIR Viz, 5/29/10 at 15:45 UTC
Infrared, volcano locations, and earthquake shown

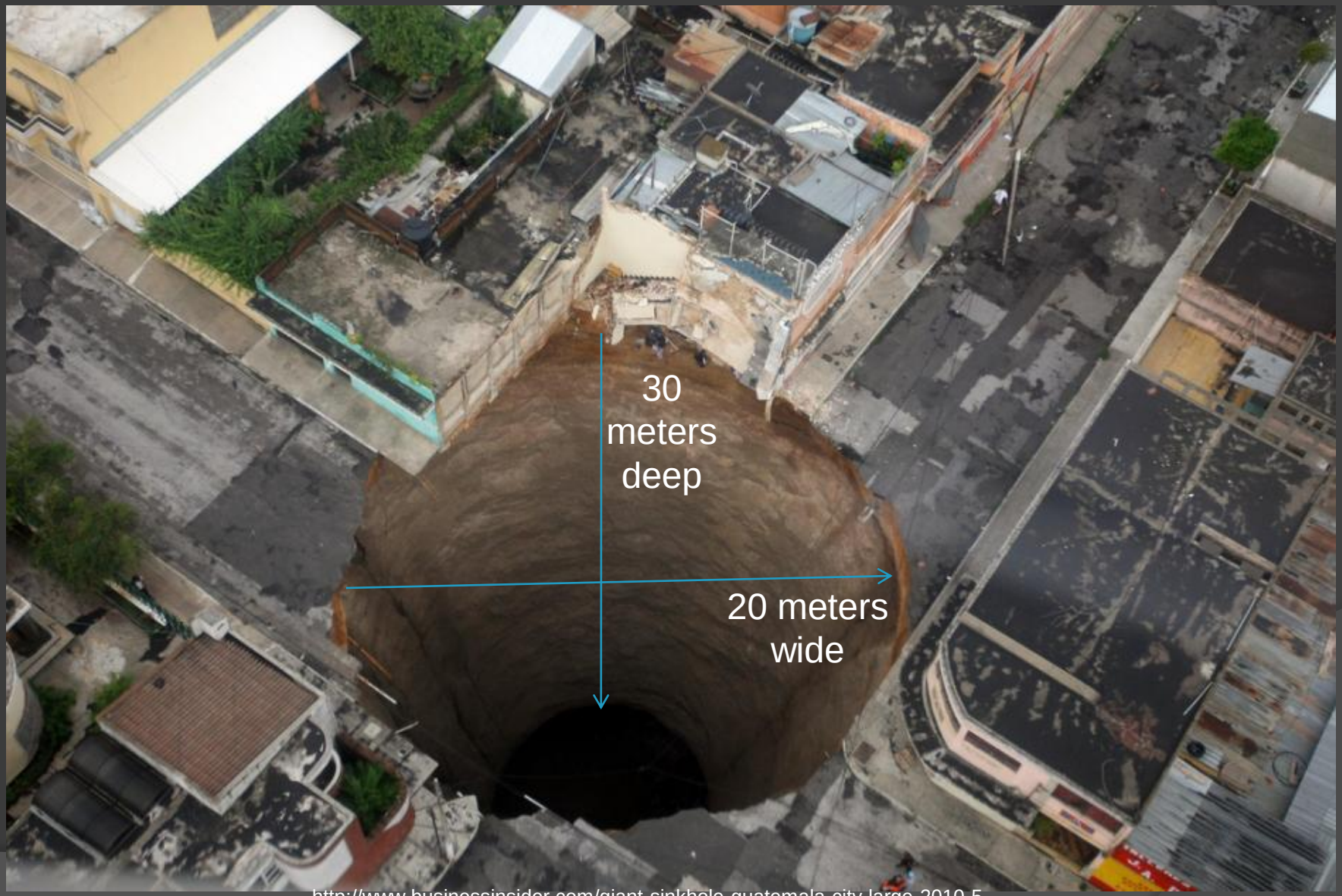
Analysis

- Heavy rainfall was evident in Guatemala during Tropical Storm Agatha
- The area in and around Guatemala City had some of the highest accumulated rainfall values, and some of the highest rainfall rates

http://www.examiner.com/x-23333-Atlantic-Hurricanes-Examiner~y2010m5d31-Tropical-Storm-Agatha-kills-99-in-Central-America-photos

- The heavy precipitation caused high landslide risks, followed by actual landslides, flooding, and…

Guatemala City: May 31, 2010



http://www.businessinsider.com/giant-sinkhole-guatemala-city-large-2010-5